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A SEMIMONTHLY ABSTRACT JOURNAL WITH INDEXES

OCTOBER 23, 1965

VOLUME 3 • NUMBER 20

N65-31250—N65-32393

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Use of funds for printing this publication approved by the Director of the Bureau of the Budget January 9, 1965

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Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

October 23, 1965

01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N65-31518# Aeronautical Research Council (Gt. Brit.)
THE CALCULATION OF PRESSURE DISTRIBUTION IN STEADY SUPERSONIC FLOW WITH ARBITRARY DOWNWASH DISTRIBUTION
Laura Klanfer London, Min. of Aviation, 1965 35 p refs Supersedes RAE-TN-AERO-2887; ARC-24952
(ARC-CP-703; RAE-TN-AERO-2887; ARC-24952) HMSO: 6s 6d

A method is established on the basis of linearized thin-wing theory for the calculation of pressure distribution, in steady supersonic flow, on wings of arbitrary planform with subsonic leading edges. An algebraic expression is derived by exact integration for the incidence contribution and a computational formula, based on Gaussian integration, is given for the general case including any prescribed camber and twist. For a uniformly cambered delta wing the results computed by this method check very closely against those obtained by Watkins' method, which is applicable in this special case. As illustrated by results computed for an uncambered ogee wing the method appears to give results of more general application than slender body or first-order piston theory. Author

N65-31519# Aeronautical Research Council (Gt. Brit.)
CALCULATED LIFT DISTRIBUTIONS IN INCOMPRESSIBLE FLOW ON SOME SWEPTBACK WINGS
J. A. Bagley and G. M. Joyce London, Min. of Aviation, 1965 20 p refs Supersedes RAE-TN-AERO-2836; ARC-24437
(ARC-CP-675; RAE-TN-AERO-2836; ARC-24437) HMSO: 4s 6d

In the course of a larger survey of some aerodynamic characteristics of a family of sweptback wings, the low-speed lift distributions were calculated. The 35 planforms considered cover a range of leading-edge sweep angles from 55° to 70°, and aspect ratios from 2 to 3.9. The results are given here, together with a comparison with other calculations and with experimental results on one particular wing. Author

N65-31532# Princeton Univ., N. J. Dept. of Aerospace and Mechanical Sciences.
AN ANALYTICAL STUDY OF THE DYNAMICS OF AIRCRAFT IN UNSTEADY FLIGHT
H. C. Curtiss, Jr. (Ph.D. Thesis) Mar. 1965 224 p refs

The dynamic response of conventional and VTOL aircraft with varying flight velocity is investigated. The general nature of the vehicle response and its departure from frozen system characteristics is evaluated. An approximation solution to linear differential equations with variable coefficients is presented which applies if the percentage change of each of the characteristic roots per unit time is small compared to the spacing of the frozen roots on the complex plane. This solution is interpreted in terms of a distortion of the frozen locus of roots on the complex plane. Properties of solutions to linear differential equations with variable coefficients are discussed. The short period motion of aircraft is examined. For stability derivatives that vary linearly with velocity, variations in time histories of pitching velocity and vertical velocity appear as a distortion of the time scale of the frozen response. The transients in angle of attack and normal acceleration will exhibit different damping characteristics. The influence of other stability derivative variations on the short period motion and some examples of higher order system dynamics are examined. R.N.A.

N65-31533# Aeronautical Research Council (Gt. Brit.)
AIRCRAFT VORTEX WAKES AND THEIR EFFECTS ON AIRCRAFT
R. Rose and F. W. Dee 1965 44 p refs Supersedes RAE-TN-AERO-2934; ARC-25419
(ARC-CP-795; RAE-TN-AERO-2934; ARC-25419) HMSO: 8s 6d

Tests have been made using a Venom traversing aircraft to determine the strength and decay, away from the ground, of vortex wakes behind Comet and Vulcan aircraft. Vortices have been found to decay rather less quickly than previously believed. The present tests show that the effects of an intersection at right angles to the wake reduce to a low level (less than 8 ft/sec equivalent gust) after 2 minutes. This result is unlikely to be any more severe for a transport aircraft. However, the estimated rolling disturbance from a glancing interception is still large at 3 minutes. Supersonic transport aircraft are expected to have similar behavior to conventional transports. Further tests to study vortices near the ground, and behind slender wing aircraft, are planned. Author

N65-31576*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
MAXIMUM LIFT-DRAG-RATIO CHARACTERISTICS OF RECTANGULAR AND DELTA WINGS AT MACH 6.9
Jim A. Penland Washington, NASA, Aug. 1965 48 p refs
(NASA-TN-D-2925) CFSTI: HC $2.00/MF $0.50 CSCL 01A

A theoretical and experimental study of a variety of rectangular and delta planform wings at a Mach number of 6.9 and a range of root-chord Reynolds numbers from 0.35×10^6 to 4.1×10^6 has been made. This study shows that good predictions of $(L/D)_{max}$ are possible on rectangular wings but that the predicted $(L/D)_{max}$ for delta wings is approximately 10 percent higher than that for experiment. Severe losses of $(L/D)_{max}$ occur with decreasing Reynolds number for all configurations and it may be inferred that $(L/D)_{max}$ values greater than about 3 will be difficult to attain at low Reynolds numbers (Reynolds numbers less than 0.1×10^6) on configurations having useful volume. The flat-bottom configuration shows the highest $(L/D)_{max}$ on simple shapes where no favorable interference can occur. Thickness ratio and aspect ratio in that order are prime factors affecting $(L/D)_{max}$ irrespective of planform geometry. Within a family of shapes the optimum shape may be determined by use of a composite plot of aspect ratio, thickness ratio, volume-area ratio, and $(L/D)_{max}$. At a Mach number of 6.9 the curve of one-half the cotangent of the average angle of attack appears to form an upper boundary for both calculated and experimental values of $(L/D)_{max}$ for rectangular- and delta-wedge wings. Author

N65-31577*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FAVORABLE INTERFERENCE EFFECTS ON MAXIMUM LIFT-DRAG RATIOS OF HALF-CONE DELTA-WING CONFIGURATIONS AT MACH 6.86
David E. Fetterman Washington, NASA, Aug. 1965 86 p refs (NASA-TN-D-2942) CFSTI: HC $3.00/MF $0.75 CSCL 01A

The characteristics of half-cone delta-wing configurations is investigated under predominantly laminar boundary-layer conditions at a Mach number of 6.86 and Reynolds number based on model length of 1.43×10^6 to determine the availability of favorable interference effects for improving the maximum lift-drag ratio $(L/D)_{max}$. Simple modification to the half-cone body to provide more volume and better volume distribution are also considered. Approximate solutions for the characteristics of half-cone winged configurations are included in the appendixes. The results indicate that only under certain criteria are favorable interference effects sufficient to cause the $(L/D)_{max}$ obtained by flat-top configurations to be superior to those obtained by flat-bottom configurations. Presently available theoretical methods are found to be inadequate to predetermine either the superiorities in flat-top $(L/D)_{max}$ due to favorable interference or the conditions under which they occur; however, experimentally determined configuration criteria for which these benefits appear to be available are established herein. Modifications to these half-cone delta-wing configurations decreased the $(L/D)_{max}$ for both flat-top and flat-bottom configurations and caused rapid deterioration in favorable interference benefits. Author

N65-31646*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STUDIES RELATING TO THE ATTAINMENT OF HIGH LIFT-DRAG RATIOS AT HYPERSONIC SPEEDS
David E. Fetterman, Arthur Henderson, Jr., Mitchel H. Bertram, and Patrick J. Johnston Washington, NASA, Aug. 1965 34 p refs
(NASA-TN-D-2956) CFSTI: $2.00 CSCL 01A

An evaluation of results of recent investigations of slender configurations to determine factors having the most significant influence on aerodynamic efficiency is presented. The results, which were obtained at a Mach number of 6.8 in air and of 20 in helium, show the effects on maximum lift-drag ratio of viscosity, body longitudinal curvature, cross-sectional shape, and fineness ratio, wing location, planform leading-edge sweep and diameter, and volumetric efficiency. In addition, the interrelationship of these factors in determining the extent of beneficial effects from favorable interference is examined. Included also are preliminary comparisons between certain merged wing-body configurations and discrete wing-body types. Author

N65-31744# Texas A&M Univ., College Station.
THE AERODYNAMIC CHARACTERISTICS OF AN AIRFOIL UTILIZING BOUNDARY LAYER AND CIRCULATION CONTROL
Edward Milton Boothe (M.S. Thesis) Aug. 1965 57 p refs (AD-617292)

A study was conducted to investigate the change in airfoil characteristics brought about by the simultaneous application of boundary layer control through leading edge blowing and circulation control through trailing edge suction. The study was based on the characteristics of a single airfoil section with only one blowing and one suction slot configuration. Airfoil model tests were conducted at a constant dynamic pressure which produced a Reynolds number of 1.27×10^6 for the two foot chord model. The maximum life of the airfoil was increased using the boundary layer control through leading edge blowing. Leading edge blowing tended to decrease the lift and pitching moment of the airfoil while increasing the drag. A combined system of blowing and suction is a partial remedy to these detrimental effects and it may eliminate the loss of lift at low angles of attack resulting from high rates of leading edge blowing. Increases in nose down pitching moment with boundary layer and circulation control would require larger downloads on a conventional tail to make longitudinal trim easier. A canard tail could alleviate the loss of lift resulting from tail download. R.N.A.

N65-31776# Royal Aircraft Establishment, Farnborough (England).
THE PLANAR WING IN HYPERSONIC FLOW [PLOSKOE KRYLO V GIPERZVUKOVOM POTOKE]
G. G. Chernyi Jun. 1965 12 p ref Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 161, no. 4, 1965 p 791–794 ref
(RAE-LIB. Trans.-1112)

The equations for the three-dimensional flow of gas in the shock layer on a planar wing of arbitrary planform are transformed into a system of equations for the coefficients of expansions of the flow variables in series of Legendre polynomials in a transformed normal coordinate. These equations are in two independent variables (the coordinates in the plane of the wing); the shock stand-off distance becomes a dependent variable, and the shock conditions are absorbed into the equations. Boundary conditions have now to be formulated and satisfied at the edge of the wing planform. The equations for the zeroth approximation (when the expansions mentioned consist of only one term) are given explicitly, and solutions of them for a finite delta wing at infinite Mach number and angles of incidence varying from 0° to 180° are described. Author

N65-31778# Royal Aircraft Establishment, Farnborough (England).
SIMILARITY LAWS FOR FLOWS PAST AEROFOILS WITH HEAT ADDITION [AHNLICHKEITSGESETZE FUR PROFILSTROMUNGEN MIT WARMEZUFUHR]
J. Zierep London, Min. of Aviation, Jun. 1965 18 p refs Transl. into ENGLISH from Acta Mechanica (Germany) v. 1, no. 1, 1965 p 60–70
(RAE-LIB-TRANS-1114)

A new similarity law for the flow around slender profiles with heat addition is derived. This law represents a generalization of the well-known relations by Prandtl-Glauert for linear

sub- and supersonic flow, and of the corresponding relations for transonic flow. A new similarity parameter appears connecting the heat supply with thickness of profile and Mach number. Information about the reduction of drag of a profile with heat addition in the sub- and supersonic range is obtained which has been derived before by Oswatitsch using a different method. Author

N65-31811# Eidcenössische Technische Hochschule, Zürich (Switzerland).
MONTE CARLO APPROACH TO THE FLOW PROBLEMS OF TURBOMACHINERY
Pramod Anand Paranjpe (Ph.D. Thesis) Juris-Verlag, 1963 86 p refs
(Prom.-3397)

The random walk approach to the problems concerning flow in turbomachinery is presented. The method is based on the application of stochastic principles to the determination of two and quasi-three dimensional flows in turbomachinery under the assumptions of inviscidity and irrotationality. The method is extensive in its application and its use is illustrated in the analysis of the incompressible and compressible flow in axial cascades as well as in radial and mixed-flow impellers. The results obtained by this technique are compared with the experimental results and with those of the other theories on the subject. About 40 hours are required for calculating the velocity distribution around a blade in cascade for an incompressible flow. The computational time increases to about 70 hours for the corresponding problem in compressible flow for three inlet Mach numbers. The determination of the velocity distribution around the impeller blade of a radial flow compressor for three different shroud forms of impeller requires about 100 hours of computation. The computational time can be greatly reduced if a digital computer can be used to simulate the random walk. E.E.B.

N65-31819# Republic Aviation Corp., Farmingdale, N. Y.
INVESTIGATION OF CONICAL AND FLAT PLATE BODIES AT HIGH REYNOLDS AND HYPERSONIC MACH NUMBERS
A. H. Lange 9 Feb. 1965 121 p refs
(Contract AF 33(657)-9697)
(RAC-2451A; RD-TR-64-44A; AD-463099)

Two slender cones, one circular, the other elliptic, a flat plate, and a number of bodies which were derived from these basic shapes by the addition of compression flares were tested at high Mach and Reynolds numbers in the Longshot I Hypersonic Free Piston Tunnel. Nitrogen was used as the test fluid. Mach numbers between 17 and 22 and Reynolds numbers between 3 and 1.5 million were achieved. Surface pressures, heat transfer, boundary layer profiles and shock locations were measured for the purpose of studying the effect of gas imperfections on the boundary layer under the various conditions imposed by the body shapes. The effects of viscous interaction, tip bluntness and roughness on pressure and heat transfer distributions were investigated and separation and transition determined. Author

N65-31862# Army Missile Command, Huntsville, Ala. Aerodynamics Branch.
THE ZERO-LIFT FOREDRAG AND BODY BASE DRAG COEFFICIENTS OF A SERIES OF RING TAIL-STRUT-BODY CONFIGURATIONS AT MACH NUMBERS FROM 0.80 TO 4.50
Paul R. Connolly May 1965 34 p refs
(RD-TR-65-8; AD-467829)

An investigation of the aerodynamic characteristics of a family of ring tail-strut-body configurations was conducted at Mach numbers from 0.80 to 4.5. Rings varying from 1.25 to 2.50 calibers in diameter and from 0.60 to 1.50 calibers in length were tested. They were tested at various longitudinal positions and with internal expansion angles from 0° to 6°. The effect of changing from circular section support struts to streamlined struts was also investigated. This report presents the zero-lift foredrag and base drag results and compares them, wherever possible, with theoretical estimates. Author

N65-31907# Weapons Research Establishment (Australia).
ON THE ASYMMETRIC SHEDDING OF VORTICES FROM SLENDER CYLINDRICAL BODIES AT LARGE ANGLES OF YAW
K. D. Thomson and D. F. Morrison May 1965 50 p refs
(WRE-TN-HSA-106)

A theoretical model is postulated for describing the asymmetric shedding of vortices from slender cylindrical bodies at large angles of yaw. Initially the two dimensional flow past a circular cylinder (i.e. the 90° yaw case) with a laminar boundary layer is examined using this model. From the description given of the formation of the Kármán vortex street a simple analysis enables an estimate to be made of the strength of the shed vortices. This vortex strength together with measured values of the Strouhal number provides sufficient information for satisfactory solutions of Kármán's expression from the drag coefficient over the Reynolds number range 10^3 to 2×10^5. Subsequently the model is extended to include the flow over yawed slender cylinders which are shedding vortices in an asymmetric manner, and reasonably satisfactory comparisons are made with experimental results. It is concluded that the aerodynamic derivatives of finned slender bodies can be subject to appreciable scale effect. Author

N65-31927# Weapons Research Establishment (Australia).
OVERALL FORCE AND MOMENT MEASUREMENTS ON A SCALE MODEL OF JABIRU MK. II
D. F. Morrison and E. R. A. Landers May 1965 85 p refs
(WRE-HSA-104)

Measurements have been made of the normal and side forces, and pitching, yawing and rolling moments on a scale model of Jabiru Mk.II carrying a twin delta head at the nose of the third stage. Tabulated data are given as overall coefficients for both the body fixed and total incidence axis systems for the third stage alone, the second and third stages combined, and the complete 3 stage vehicle with the first and second stage fins both in line and interdigitated. Sufficient data are presented to enable the effectiveness of the stabilizing surfaces to be determined. The most important results are also presented graphically. Author

N65-31972# Air Force Systems Command, Kirtland AFB, N. Mex. Air Force Weapons Lab.
SOME COMMENTS ON NEWTONIAN IMPACT THEORY Technical Report, Apr. 1964–Apr. 1965
Chester F. Dean Jun. 1965 70 p refs
(WL-TR-64-176; AD-617551)

This report contains the theory which is basic to the understanding of the Newtonian impact theory and high-speed, high-altitude aerodynamics. Curves are presented for cones with semicone angles from 10 to 20 degrees in increments of 1 degree plotted with the various aerodynamic coefficients (c_m, C_x, C_n, C_L, and C_D) against cone angle of attack (from 0 to 15 degrees). A computer listing of the program which generated these curves is also presented. This report provides curves which utilize cone-shaped reentry vehicles. Other shapes can be utilized based on the theory presented but only the cone has been developed in this report. Author

N65-31978# Aeronautical Research Council (Gt. Brit.)
WIND TUNNEL MEASUREMENTS OF THE UNSTEADY PRESSURES IN AND BEHIND A BOMB BAY (CANBERRA)

J. E. Rossiter and A. G. Kurn Supersedes RAE-TN-AERO-2845; ARC-24645 London, HMSO, 1965 23 p refs
(ARC-CP-728; RAE-TN-AERO-2845; ARC-24645)

The unsteady pressures acting in and behind the bomb bay of a 1.20 scale model of the Canberra aircraft have been measured in the 8 ft × 6 ft transonic tunnel. The unsteady pressures are described by their r.m.s. values and by amplitude and correlation frequency spectra. Time average values of the pressures were also measured. The results show that the Canberra bomb bay is of the "shallow type" in which the airflow enters the bay and attaches to the roof before being deflected out by the rear bulkhead. Pressure fluctuations are most intense in the vicinity of the rear bulkhead. Pressure fluctuations are most intense in the vicinity of the rear bulkhead and on the roof of the bay where the flow attaches. Changing the Mach number from 0·3 to 0·6 has in general little effect on the unsteady pressures (when expressed non-dimensionally) but increasing incidence up to ten degrees produces some decrease in their magnitude. Author

N65-32020# Aeronautical Research Council (Gt. Brit.)
TRANSONIC COMPRESSOR NOISE: THE EFFECT OF INLET GUIDE VANE/ROTOR SPACING
D. A. Kilpatrick and D. T. Reid London, HMSO, 1965 30 p refs Supersedes NGTE-R-257; ARC-25641; see X65-15155)
(ARC-R&M-3412; NGTE-R-257; ARC-25641) HMSO: 12s 6d

Comprehensive noise measurements were made in the inlet duct of a model of a typical two-stage transonic fan. The tests covered a range of variations in the inlet guide/rotor axial spacing from normal, in small increments, to a spacing of about one blade-chord length. The effect of compressor speed and flow is pronounced for both the discrete blade tone and the vortex noise. As the axial spacing is increased the discrete blade tone output is reduced, the vortex noise being virtually unaffected. Author

N65-32022# Aeronautical Research Council (Gt. Brit.)
WIND TUNNEL TESTS AT MACH NUMBERS UP TO 1.8 ON A MODEL WITH 1/36 SCALE WINGS AND NACELLES OF A TWIN-ENGINE SUPERSONIC AIRCRAFT (BRISTOL 188)
E. P. Sutton, P. G. Hutton, and L. C. Squire London, HMSO, 1965 67 p refs Supersedes RAE-TN-AERO-2543, ARC-20303
(ARC-CP-798; RAE-TN-AERO-2543; ARC-20303) HMSO: 12s 6d

Tests have been made in the R.A.E. Bedford 3 foot tunnel on a model representing the exposed wing and nacelles of the Bristol 188 aircraft, mounted on an ogive-cylinder body. The wing was unswept inboard but had a swept-back leading edge outboard of the nacelles. Lift, drag, and pitching moment, and rolling moment due to aileron deflection, were measured at Mach numbers between 0.7 and 1.02 and between 1.4 and 1.8 at a Reynolds number of 1.7×10^6 based on mean aerodynamic chord. At high subsonic speeds separations on the unswept inner wing dominate the characteristics of the model at incidence. Fitting leading edge vortex generators delays the effects of leading edge separation. The horn-balanced ailerons are effective throughout the test range. The surface oil-flow technique was used as an aid to interpretation of the measurements. Author

N65-32023# Aeronautical Research Council (Gt. Brit.)
WIND TUNNEL MEASUREMENTS AT MACH NUMBERS UP TO 2.80 OF THE EFFECTS OF GULLING ON THE LONGITUDINAL AND LATERAL STABILITY AND DRAG OF A CAMBERED, SLENDER OGEE WING
T. A. Cook London, HMSO, 1965 30 p refs Supersedes RAE-TN-AERO-2974, ARC-26700; see X65-13379
(ARC-CP-803; RAE-TN-AERO-2974; ARC-26700) HMSO: 6s

Tests have been made at M = 0.31, 1.40, 1.80, 2.20, 2.40 and 2.80 on a cambered, slender ogee wing with spanwise camber designed to reduce the size of rolling moment due to sideslip at low speed. The results are compared with those for a similar model without spanwise camber and show that, at M = 0.31, gulling has resulted in loss of $-l_v$ as required, together with reductions in y_v and n_v and an increase in non-linear lift, probably at the drooped tips. Similar effects are obtained at supersonic speeds, though the effect of gulling on $-l_v$ diminishes with increasing Mach number. At supersonic speeds, there is a small increase of drag at zero lift, which appears to be explained by the increase of surface area of the gulled wing. Author

N65-32024# Aeronautical Research Council (Gt. Brit.)
WIND TUNNEL TESTS ON A 1/12th SCALE MODEL OF THE BRISTOL TYPE 188 RESEARCH AIRCRAFT WITH RECTANGULAR, WEDGE INTAKES AT MACH NUMBERS FROM 2.0 TO 2.7
T. A. Cook London, HMSO, 1965 33 p refs Supersedes ARC-25028
(ARC-CP-817; ARC-25028) HMSO: 6s 6d

A 1/12th scale model of the Bristol Type 188 research aircraft with modified intakes has been tested in the 8 ft × 8 ft wind tunnel at R.A.E., Bedford, at Mach numbers of 2.00, 2.20, 2.40 and 2.70. The tests were made to investigate the effects of rectangular, wedge intakes on the model by comparing the results with those of previous tests[1,2] in which the model had axi-symmetric conical centerbody intakes. The comparison shows the effects of the new intakes on longitudinal and lateral stability, drag and tailplane power, the most important of these being a forward shift of approximately 10% $\bar{c}$ in aerodynamic center and a reduction of directional stability. Author

N65-32109# North American Aviation, Inc., Los Angeles, Calif.
ON THE HYPERSONIC FLOW OVER A DELTA WING WITH VERY SUPERSONIC LEADING EDGES
Norman D. Malmuth 1 Jun. 1965 25 p refs Revised
(Contract AF 49(638)-1477)
(NA-65-275; AFOSR-65-0757; AD-618294)

For the case of very supersonic leading edges, the inviscid hypersonic flow over the windward side of a symmetrical flat-plate delta wing at incidence is analyzed. The limit selected is that the incidence is of higher order than the aspect ratio as the incidence tends to zero at infinite Mach number. In this framework, the flow regions consist of a two-dimensional domain adjacent to the leading edges and a central conefield. The flow quantities in the central region represent small, linear, rotational perturbations about the zero sweep flow. A Riemann-Poincaré boundary value problem for the pressure perturbation is formulated. An additional condition involving the sidewash at the shock is found to be required to resolve the indeterminacy of the foregoing boundary value problem. Series solutions and numerical results are presented for the shock shape and the pressure. The behavior of the latter quantity is found to be similar to that given by the irrotational linear solution for the supersonic leading edge case. Finally, the relationship between the present application and others involving diffraction problems and corner flows is indicated. Author

N65-32221# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.
THEORETICAL DETERMINATION OF ROTOR BLADE HARMONIC AIRLOADS
R. H. Miller Aug. 1964 125 p refs
(Contract NOw-62-0100-d)
(TR-107-2; AD-619048)

A solution is presented to the problem of determining rotor blade harmonic loading which includes the unsteady aerodynamic effects and the actual three-dimensional wake geometry. The problem is formulated for the complete case of the three-dimensional rotor with a finite number of blades in forward flight. Methods of solution are discussed starting with an approach in which airloads on the blade generated by the near wake are treated using lifting surface theories, while the far wake is treated using the lifting line approximation. Analytical solutions are obtained for the three-dimensional rotor in vertical flight. This results in a simple solution for the lift deficiency function and provides a check on numerical solutions obtained using the complete theory. Relationships required for the solution of the complete problem of airloads on a three-dimensional rotor in forward flight are developed. The concept of a nonrigid wake is introduced. It is shown that a more careful definition of the wake geometry than the assumption of a rigid spiral of constant spacing becomes important at the lower advance ratios. Approximate solutions are compared with the more exact theory. R.N.A.

N65-32225# North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.

UNSTEADY AERODYNAMICS FOR ADVANCED CONFIGURATIONS. PART I: APPLICATION OF THE SUBSONIC KERNEL FUNCTION TO NONPLANAR LIFTING SURFACES

H. T. Vivian and L. V. Andrews Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., May 1965 120 p refs

(Contract AF 33(657)-10399)

(SID-64-1512-1; FDL-TDR-64-152, Pt. 1; AD-618096)

In this part, equations for pressure distributions and generalized aerodynamic forces are derived for a thin nonplanar lifting surface in simple harmonic motion at subsonic speeds. A digital computer program, written in Fortran IV, is also presented herein. The computer program will generate up to a ten by ten matrix of generalized aerodynamic forces when given data for the geometry of a planar lifting surface with a folded planar tip, the flight Mach number, the reduced frequency of motion, and some control constants. Control surface deflections are not accounted for in this study. The kernel function method given by Watkins, Runyan, and Woolston, which relates the pressure distribution to the downwash on a planar lifting surface, has been extended and applied to a nonplanar lifting surface. Hsu's technique of employing Gaussian quadrature formulas is used when integrating the product of the kernal function and the lift function over the planform area. Recommendations are made to extend the method to account for blunted leading edges and the accompanying airfoil thickness and to account for control surface deflections. Author

N65-32295# North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.

UNSTEADY AERODYNAMICS FOR ADVANCED CONFIGURATIONS. PART III: ELLIPTICAL-CONICAL WING IN LINEARIZED UNSTEADY TRANSONIC FLOW

E. Albano and L. V. Andrew Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., May 1965 33 p refs

(Contract AF 33(657)-10399)

(SID-64-1512-3; FDL-TDR-64-152, Pt. II; AD-618083)

Pressure distributions were calculated for an elliptic cone performing plunging oscillations at sonic speed. The objective was to study the effect of blunt leading edges and wing thickness. Second order expressions in terms of the parameter (frequency times aspect ratio squared) for velocity potentials, pressure coefficients, and total lift and moment were derived using an iteration procedure developed by Adams and Sears and extended for unsteady transonic flow by Landahl. The results indicate the possibility of developing simple formulas which will give accurate corrections throughout a wide speed range for the effects of leading-edge bluntness on airfoil pressure distributions. Author

N65-32355# Weapons Research Establishment (Australia).

ON THE ASYMMETRIC SHEDDING OF VORTICES FROM SLENDER CYLINDRICAL BODIES AT LARGE ANGLES OF YAW

K. D. Thomson and D. F. Morrison May 1965 54 p refs

(WRE-TN-HSA-106)

A theoretical model is postulated for describing the asymmetric shedding of vortices from slender cylindrical bodies at large angles of yaw. From the description given of the formation of the Kármán vortex street a simple analysis enables an estimate to be made of the strength of the shed vortices. This vortex strength together with measured values of the Strouhal number provides sufficient information for satisfactory solutions of Kármán's expression for the drag coefficient over the Reynolds number range 10^3 to 2×10^5. Subsequently the model is extended to include the flow over yawed slender cylinders which are shedding vortices in an asymmetric manner, and reasonably satisfactory comparisons are made with experimental results. It is concluded that the aerodynamic derivatives of finned slender bodies can be subject to appreciable scale effect. The Strouhal number based on the cross-flow velocity component appears to be an important similarity parameter in correlating flows over yawed cylindrical bodies. Author

N65-32365# Lockheed Missiles and Space Co., Sunnyvale, Calif.

ON THE INFLUENCE OF EXTERNAL DRAG ON THE STABILITY OF AN ELASTIC STRUCTURE UNDER FREE FLIGHT CONDITIONS

N. G. Krasonoshapka [1965] 7 p refs Transl. into ENGLISH from Prikl. Mekhan. i Tekhn. Fiz. (USSR), v. 1, no. 6, 1965 p 78–84

The influence of the drag force on the stability of the motion of an elastic system, replaced approximately by a one-dimensional object, is considered. An investigation is made of just the mechanical stresses on the stability of an elastic frame of a flying vehicle without taking account of temperature effects. Various cases are considered of the application of a drag force to a moving body. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N65-31752# Federal Aviation Agency, Atlantic City, N. J. National Aviation Facilities Experimental Center.

EVALUATION OF PLANS FOR THE CONTROL OF AIR TRAFFIC IN THE GREATER KANSAS CITY TERMINAL AREA Final Report

Enoch H. Wright May 1965 40 p

(RD-65-47)

Plans for the control of air traffic in the Greater Kansas City terminal area were evaluated to determine optimum control procedures, traffic flow patterns and equipment configurations. The dynamic air traffic control simulation facilities at the National Aviation Facilities Experimental Center were used in conducting the evaluation. The Federal Aviation Agency Central Region concept combined the control of instrument flight rule traffic operating at Kansas City Municipal, Mid-Continent International, Richards-Gebaur AFB, Olathe NAS, Sherman AAF and St. Joseph Airports at the Kansas City Terminal Radar Approach Control Facility. In addition the concept required that both Kansas City Municipal Airport and the Mid-Continent International Airport be considered as a primary terminal. The evaluation was conducted accordingly. It was concluded that the control procedures, traffic flow patterns, and equipment configurations contained in the final plan were optimum. It was recommended that the final plan be considered for implementation. Author

N65-31779# Royal Aircraft Establishment, Farnborough (England).
CURRENT ASPECTS OF THE THEORY OF STABILITY AND CONTROL OF AIRCRAFT, PART I
T. Hacker London, Min. of Aviation, May 1965 35 p refs Transl. into ENGLISH from Rev. Mecan. Appl. Acad. RPR (Rumania), v. 8, no. 2, 1963 p 193–216
(RAE-LIB-TRANS-1106)

A survey is given of some current aspects and methods of working in the theory of stability and control of aircraft with emphasis on the necessity for taking into account the influence of control (either by a pilot or an automatic device). Author

N65-31789# EDO Corp., College Point, N. Y.
INSTRUMENTATION AND PRELIMINARY FLIGHT TESTS OF THE JRF-5 EQUIPPED WITH A GRUNBERG HYDROFOIL SYSTEM Final Engineering Report
Oct. 1964 32 p
(Contract NOas-60-6096-c)
(Rept.-6652; AD-460340)

Instrumentation and flight tests of a JRF-5 Grundberg supercavitating hydrofoil seaplane are reported. Detailed descriptions of the flight test instrumentation, its installation, operation, and calibration are given. The findings of the flight tests are briefly summarized. Configuration modification and additional flight tests were required because the full scale aircraft did not display the stable behavior and good spray characteristics observed in the towing tank model tests. J.M.D.

N65-31844# United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.
CH-53A HELICOPTER DEMONSTRATION DATA REPORT
R. L. Kuzma, T. A. Gaieski, and W. Marlatt 19 Dec. 1964 192 p
(Contract NOw-63-0150f)
(SER-65254; AD-463481)

Flight test data are submitted for structural, aerodynamic, power plant, and equipment tests. Also, the program for future testing and demonstration of this helicopter is outlined in detail. The CH-53A design consists of a single 6 bladed main rotor with a 4 bladed anti-torque tail rotor. The main rotor head is equipped with automatic blade folding to reduce preparation time for storage. The aircraft is powered by two turbine engines which are mounted individually on each side of the fuselage, forward of the main rotor transmission. The flight control system consists of the normal cyclic control and rudder pedal installations with a cane type collective control stick. E.E.B.

N65-31895# David Taylor Model Basin, Washington, D. C. Aerodynamics Lab.
DETERMINATION OF THE CRUISE RANGE OF A HYDROGEN-FUELED, AIR-BREATHING HYPERSONIC AIRCRAFT
John R. Krouse May 1965 27 p refs
(DTMB-2010; AERO-1089; AD-467687)

The cruise range of a typical hydrogen-fueled, air-breathing, hypersonic aircraft is obtained for both a simple and a modified Breguet flight path. The analysis indicates that the modified Breguet flight path, in which the restriction of constant specific fuel consumption is relaxed (realistic variation with Mach number and altitude is permitted), results in a cruise range that is approximately three percent greater than that predicted by the simplified Breguet range equation. In either case, virtually semi-global range is obtained when the cruise range is superimposed upon the additional distance covered during climb and descent. Author

N65-31905# Royal Aircraft Establishment, Farnborough (England).
SOME RECENT ASPECTS OF THE THEORY OF STABILITY AND CONTROL OF AIRCRAFT. PART 2: PROBLEMS OF STABILITY AND CONTROL CONNECTED WITH CERTAIN PRESENT-DAY FLIGHT AND OPERATING CHARACTERISTICS
T. Hacker Apr. 1965 29 p refs Transl. into ENGLISH from Rev. Mecan. Appl., Acad. Rep. Populaire Roumaine, v. 8, no. 3, 1963 p 393–412
(RAE-LIB-TRANS-1107)

The second part of the paper enumerates some of the most important problems of stability and control which have been the subject of investigation of recent years. Problems touched on relate to increased velocities of flight, flight at low speeds, the necessity for taking into account the change in certain parameters with height, with examination of non-uniform basic motion and constantly acting disturbances. Author

N65-31945# General Electric Co., Cincinnati, Ohio. Advanced Engine and Technology Dept.
XV-5A LIFT FAN FLIGHT RESEARCH AIRCRAFT Quarterly Technical Progress Report, 17 Feb.–15 May 1964
Jul. 1964 94 p
(Contract DA-44-177-TC-715)
(QTPR-10; AD-461017)

Propulsion system deliveries were completed with acceptance of the last spare lift fan. Number one A/C completed modification and ground tests prior to full scale wind tunnel tests. Engineering design and analysis was completed for the higher loading in the exit louver actuation system. Both aircraft completed systems functional tests. Nose gear redesign and successful dynamic and static tests were completed. A systems failure evaluation was conducted on the flight simulator to establish emergency procedures. Author

N65-31966# Bolt, Beranek, and Newman, Inc., Los Angeles, Calif.
FACTORS INFLUENCING THE NOISE EXPOSURE UNDER THE LANDING PATH FOR JET TRANSPORT AIRCRAFT
A. C. Pietrasanta Mar. 1965 40 p refs
(Contract FA-64-WA-4949)
(FAA-ADS-39; AD-617765)

Calculations have been made to determine the quantitative effect on the noise exposure under the landing path of changes in runway threshold location, glide slope angle, and engine power setting. Each of these factors has been examined independently, i.e., with all other conditions held constant, for operation of a turbofan-powered Convair 990 and a turbojet-powered Boeing 707-120. Changes in noise exposure are described in terms of changes in perceived noise level and/or

changes in the area enclosed by equal perceived-noise-level contours for a range in glide slope angles from 2-1/2° to 6°, runway threshold displacements of 1000 feet and 2000 feet, and four different engine power settings from approximately 60% thrust downward. The results can apply to all four-engine commercial jet airliners in operation today. Author

N65-31982# Aeronautical Research Council (Gt. Brit.)
A WIND-TUNNEL INVESTIGATION OF THE DIRECTIONAL AND LONGITUDINAL STABILITY OF THE *JAVELIN* AIRCRAFT AT TRANSONIC SPEEDS, INCLUDING COMPARISON WITH FLIGHT TEST RESULTS
E. P. Sutton and A. Stanbrook London, HMSO, 1965 47 p refs Supersedes RAE-TN-AERO-2563; RAE-AERO-2632; ARC-20582; ARC-22083
(ARC-R&M-3403; RAE-TN-AERO-2563; RAE-AERO-2632; ARC-20582; ARC-22083) HMSO: £1 2s 6d

Directional and longitudinal stability measurements have been made on a 1/72 scale model of the Javelin aircraft at Mach numbers up to 1·12 in R.A.E. Bedford, 3 ft Wind Tunnel. Observations were made of the flow over the fin and the wing by the oil-flow technique. The results show directional instability near sonic speed, as observed in flight, due to shock-induced separation on the fin; this appears to have been caused by the wing trailing-edge shock wave, strengthened by the flow fields of the fin and rear fuselage. A small change in the shape of the rear fuselage delayed the separation to a higher wing incidence and eliminated the instability. For the model with the tail-on, the curves of pitching moment against normal force had stable slopes except near zero lift at isolated Mach numbers. The stability decreases at high incidence at M = 0·7 and at moderate incidences around M = 0.93. Flight and tunnel test results were in good qualitative agreement. The significant effect of a small distortion of the fuselage shape at the tail (such as might be made to accommodate a supporting sting) on directional stability is of general importance from the point of view of wind-tunnel testing. Author

N65-32007# Bolt, Beranek, and Newman, Inc., Los Angeles, Calif.
NOISE CONTOURS FOR SHORT AND MEDIUM RANGE TRANSPORT AIRCRAFT AND BUSINESS AIRCRAFT
Dwight E. Bishop Mar. 1965 47 p refs
(Contract FA-64-WA-4949)
(FAA-ADS-35; AD-617763)

Generalized noise contours, in terms of the perceived noise level, are presented for takeoff and landing operations of: (1) two and three engine, short and medium range turbojet and turbofan transport aircraft, (Boeing 727, BAC 1-11, Douglas DC-9 and Sud Aviation Caravelle 3 and 6); (2) multi-engine turbojet and turbofan business aircraft (Jet Commander 1121, Dassault Falcon, Hawker Siddeley D. H. 125, Lear Jet 23, Lockheed JetStar and North American Sabreliner); and (3) two-engine propeller transport and business aircraft. Estimates of ground runup noise for aircraft in groups 1 and 2 above are also presented. The noise contours are based on noise measurements and estimates. The noise contours extend the scope of aircraft noise information for land use planning in the vicinity of airports. The noise information should be particularly helpful in describing the noise environment in and about smaller airports not regularly handling military or large civil jet transport aircraft. Author

N65-32047*# Honeywell, Inc., Minneapolis, Minn. Aeronautical Div.
STUDY-FLUID FLIGHT PATH CONTROL SYSTEM Final Report
30 Jul. 1965 230 p refs *Its* Rept.-20175-FR1
(Contract NAS4-763)
(NASA-CR-64541) CFSTI: HC $6.00/MF $1.50 CSCL 01D

Advanced concepts for lateral and pitch flight path stabilization of light aircraft were studied. A major consideration was the suitability of the concept configuration for pure-fluid mechanization. The concept configurations were evaluated on an analog simulation of the Cessna 310 airplane. Ramp and step wind inputs were used as disturbances in the evaluation. The results of the study are tabulated and compared with certain pilot acceptance and ease of mechanization criteria. Author

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N65-31517# Los Alamos Scientific Lab., N. Mex.
CAPACITOR BANK CHARGING SYSTEM
T. M. Sprague [1965] 17 p Sponsored by AEC

Specifications are presented for the power supply requirements and power supply components of a large dc capacitor bank charging system. Characteristics of the saturable reactor control chosen for the capacitor charging circuits are outlined. The theory of operation and design criteria for the control system are also discussed. Schematic circuit diagrams and performance curves are included. R.N.A.

N65-31554*# Douglas Aircraft Co., Newport Beach, Calif. Astropower Lab.
INORGANIC ION EXCHANGE MEMBRANE FUEL CELL Quarterly Progress Report
C. Berger, M. P. Strier, and G. Belfort Jul. 1965 55 p refs
(Contract NAS3-6000)
(NASA-CR-54460; SM-46221-Q4) CFSTI: HC $3.00/MF $0.50 CSCL 10A

Continued research designed to achieve the maximum possible fuel cell performance is reported. A new performance target level of 0.7 volts at 50 mA/cm^2 was established by incorporating the optimum fuel cell design features with the optimum membrane-catalyst-electrode configuration. A larger membrane having a diameter of four inches also afforded favorable performance characteristics under similar operational conditions. Studies focusing on improving the membrane-catalyst-electrode configuration, particularly from the standpoint of reduction of contact resistances indicated that a 50/50 platinum-palladium black catalyst mixture was a more effective catalyst system than platinum black alone. Results of the following fuel cell tests are presented: standard fuel cell tests, compact fuel cell life tests, fuel cell tests with palladium and iridium catalyst material, fuel cell tests with various types of tantalum and stainless screen electrodes, and fuel cell tests with unitized membrane-catalyst-electrode structures. S.C.W.

N65-31555*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ELECTRODYNAMIC MERCURY PUMP
A. Vary Washington, NASA, Sep. 1965 19 p
(NASA-TN-D-2965) CFSTI: HC $1.00/MF $0.50 CSCL 10B

Problems associated with high-pressure, electromagnetic pumping of mercury were investigated. Electromagnetic pressure development with mercury was difficult to achieve because of two factors: first, mercury wetting of the flow passage surface was not readily attained; second, induction heating of the mercury resulted in vapor formation in the pump flow channel causing loss of developed pressure. Satisfactory results were obtained by chemical and thermal conditioning techniques developed to induce mercury wetting. The problem of overheating was resolved by means of a novel pump cell design that assured better electrical continuity and efficient heat removal. The resultant pump cell had a developed pressure capability of approximately 500 pounds per square inch and was able to meet the following design requirements: output pressure, 350 pounds per square inch; mercury flow rate, 150 pounds per hour; and operating temperature, 600° F. The pump was operated for over 400 hours of which over 200 hours were accumulated in a two-phase corrosion loop under SNAP-8 conditions of pressure and temperature. Author

N65-31649*# Lear Siegler, Inc., Cleveland, Ohio. Power Equipment Div.
BRUSHLESS ROTATING ELECTRICAL GENERATORS FOR SPACE AUXILIARY POWER SYSTEMS
J. N. Ellis and F. A. Collins 26 Apr. 1965 74 p
(Contract NAS3-2783)
(NASA-CR-54321) CFSTI: HC $3.00/MF $0.75 CSCL 10A

The final report on the study of brushless rotating electrical generators for space auxiliary power systems describes eighteen types of brushless A.C. generators and recommends four for aerospace use. The reader is referred to the Topical Report NASA CR-54320 for the electrical and mechanical analysis methods resulting from the study. The Topical Report consists of five volumes containing 10 design manuals and 9 Fortran computer programs for use in calculating the electrical performance and characteristics of brushless A.C. generators. It contains generator selection aids, a discussion of gas bearings for generators, and a discussion of the problem of critical speeds. The report includes a Fortran computer program for generator thermal analysis plus examples, test data, derivations and discussions. Author

N65-31656 Joint Publications Research Service, Washington, D. C.
THE EFFECT OF FRICTION ON THE DYNAMICS OF SERVO SYSTEMS
G. S. Chernorutskiy *In its* Izv. VUZov: Instr. Building, Vol. VIII, No. 3, 1965 p 51–58 refs (See N65-31650 20-14) CFSTI: $5.00

This article presents a method of accounting for the effect of friction on the dynamics of servo systems with random selection of the magnitude of the mechanical resistance. It is shown that in this case all the dynamic indices of the system have a random nature. The concept is introduced of the probability of the realization of given dynamic properties of a system which can be treated as the reliability of the dynamic indices. Author

N65-31657 Joint Publications Research Service, Washington, D. C.
SOME QUESTIONS OF THE THEORY OF A SYNCHRONOUS SERVOSYSTEM WITH TWO DEGREES OF FREEDOM
Ye. M. Karpov and Yu. M. Barkovskiy *In its* Izv. VUZov: Instr. Building, Vol. VIII, No. 3, 1965 p 59–64 ref (See N65-31650 20-14) CFSTI: $5.00

This paper considers the principle of operation of a synchronous servo system with two degrees of freedom. The synchronizing torques are determined along each of the axes of rotation as well as their dependence on the error angles. Conditions are established for which the signs of the synchronizing torques are the same as the signs of the error angles. Author

N65-31661 Joint Publications Research Service, Washington, D. C.
EQUIVALENT CIRCUITS OF THE STEPPING MOTOR IN PULSED AUTOMATIC SYSTEMS
Ye. M. Dondik *In its* Izv. VUZov: Instr. Building, Vol. VIII, No. 3, 1965 p 86–93 refs (See N65-31650 20-14) CFSTI: $5.00

We consider variants of automatic systems with a stepping actuator motor. Equivalent structural circuits of the stepper motor are presented which permit use of the theory of nonlinear pulsed automatic systems for analysis. Author

N65-31685# Eagle-Picher Co., Joplin, Mo. Couples Dept.
LOW TEMPERATURE TESTING OF BATTERY BA-494 ( )/U Final Report, Jan.–Apr. 1965
[1965] 120 p
(Contract DA-28-043-AMC-01222(E))
(AD-617351)

This report presents the data obtained in testing the BA-494 ( )/U at temperatures from 95° F down to 70° F in 5° F increments. In addition to the temperature study, the rates of discharge were varied from the original specifications as well as modifications in instrumentation. Information of considerable value and interest has been gained through this test program. Some difficulties were encountered which will prove to be advantageous in that recommended corrective actions may be taken or alternates considered. Author

N65-31855# Federal Aviation Agency, Washington, D. C. Systems Research and Development Service.
FEASIBILITY OF RECHARGING FAA IN-SERVICE DRY CELL BATTERIES Final Report
Francis D. Corbin Aug. 1965 23 p refs
(RD-65-86)

The report explains the feasibility of recharging presently used carbon-zinc batteries and considers the use of other types which may have a better charge acceptance. It was found that, although the carbon–zinc battery is listed as a primary cell, i.e., not rechargeable, it actually has a limited recharge capability provided the charging is done soon after discharge. Since most of our batteries are for emergency use, the loss of capacity is due to self-discharge rather than actual use. Inasmuch as capacity lost by self-discharge cannot be replaced by charging, it is not recommended that a recharging program for carbon-zinc batteries be undertaken. Other types of batteries are better adapted for standby application, such as radiological equipment, and are more rechargeable than the carbon–zinc type. Except for alkaline manganese dioxide–zinc batteries, the cost of these other types is so high that their use cannot be justified. Recommendations are made for the use of secondary manganese dioxide–zinc batteries at some locations. Author

N65-31882# Eagle-Picher Co., Joplin, Mo. Couples Dept.
INVESTIGATIONS LEADING TO THE DESIGN AND DEVELOPMENT OF MAGNESIUM/MAGNESIUM PERCHLORATE BATTERIES Third Quarterly Progress Report, Jan. 1–Mar. 31, 1965
James Sharpe 30 Apr. 1965 32 p
(Contract DA-28-043-AMC-00221(E))
(Rept.-3; AD-618497)

Magnesium–magnesium perchlorate–mercuric oxide battery systems were constructed and discharged. They exhibited good capacity and voltage tolerance for most of the

discharge rates at +75° F. Low temperature and high temperature studies of these batteries, conducted at the same discharge rates, demonstrated that this system operates at high efficiency over a temperature range of −40° to +125° F. It was shown that an activated stand of one week with less than 10% capacity loss can be expected from a mercuric oxide cell using AZ 31. R.N.A.

N65-31918# Brown, Boveri and Co., Ltd., Heidelberg (West Germany).
INVESTIGATIONS ON EMISSION MATERIALS FOR THERMIONIC CONVERTER INFLUENCE OF CsF ON ELECTRON WORK FUNCTIONS OF W, Ta AND Mo [UNTERSUCHUNGEN UBER EMITTERSUBSTANZEN FUR THERMIONIC-KONVERTER—EINFLUSS VON CsF AUF DIE ELEKTRONENAUSTRITTSARBEIT VON W, Ta UND Mo]
A. Minor and R. Langpape Brussels, EURATOM, 1965 21 p refs In GERMAN; ENGLISH summary
(Contract EURATOM-001-63-4 CODD)
(EUR-2283.d) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 40 Belg. Fr.

The influence of the addition of cesium fluoride in a cesium thermionic converter has been investigated. The electron emission of W, Ta, and Mo has been measured under free field conditions of CsF vapor at various pressures and various emitter temperatures. From this, the work function has ben calculated using the Richardson equation. The results show an increase of the work function with increasing CsF vapor pressure but only above a certain CsF vapor pressure which depends on the emitter temperature. In the same way the work function of Mo was determined in a mixture of Cs and CsF vapor. An independent variation of the Cs and CsF vapor pressures has been accomplished. The results demonstrate that the Cs vapor pressure required to lower the work function to a certain value could be considerably decreased if a sufficiently high CsF vapor pressure in the cesium diode could be permanently maintained. The measured results cannot be described with the theory of Rasor and Warner. Author

N65-31944# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
RESEARCH ON NEW CONCEPTS IN ENERGY CONVERSION Quarterly Technical Progress Report, 1 Mar.–31 May 1965
W. D. Jackson, G. A. Brown, J. L. Kerrebrock, and R. E. Stickney Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., 15 Jun. 1965 35 p refs
(Contract AF 33(615)-1083)
(QTPR-7; AD-467267)

Two forms of closed cycle magnetohydrodynamic power generations systems and thermionic energy converters are being investigated. Construction is continuing on a flexible test facility for the condensing ejector of the liquid metal magnetohydrodynamic power system. An experimental study of the magnetohydrodynamic induction generator was completed and the results are discussed. Magnetohydrodynamic channel flow measurements with the pitot tube probe were completed. Progress in systems with alkali metal vapor generators includes modifications of the test section for the potassium loop to solve the leakage problem, completion of a performance potential study of potassium vapor magnetohydrodynamic generators for space power, and selection of design parameters for the large segmented electrode generator experiment. Thermionic emission measurements from a tungsten crystal are being repeated using a new crystal. A realistic model for alkali metal interactions was proposed. Level shift and broadening have been calculated and the exchange energy calculations are in progress. An optical pumping experiment was performed to measure the importance of the autoionization reaction of excited cesium. R.N.A.

N65-32147# European Space Vehicle Launcher Development Organization, Paris (France).
A CONSIDERATION OF THE SPECIFIC WEIGHT OF SOLAR CELLS FOR POWERING SPACE VEHICLES
M. M. Gilli Jul. 1965 28 p refs Revised
(ELDO-TM/F/7, Rev.)

The specific weights of power sources for space vehicles are considered in the development of a method for the efficient mounting of solar cells. Reliability and cost are other parameters considered. A tabulation is presented of data on power supplies of various satellites. M.R.W.

N65-32375# Radio Corp. of America, Lancaster, Pa. Direct Energy Conversion Dept.
THE DEVELOPMENT OF AN IMPROVED THERMIONIC ENERGY CONVERTER Final Technical Report
May 1965 84 p
(Contract AT(30-1)-3429)
(NYO-3429-4) CFSTI: $4.00

A feasibility study was made to determine if thermionic energy converters could be designed that operate with cesium in the vapor phase only. A detailed analysis is presented and includes schematics and graphs. Emphasis was on redesign of converters using the most compatible materials; fabrication of the converters using the latest assembly procedures; development of processing techniques for reservoirless converters; converter performance evaluation; life test of reservoirless converters; and post test analysis, using radio tracer techniques to determine materials incompatible with cesium. It was shown that reservoirless converters which operate with cesium in the vapor state only are feasible. For lower envelope temperatures, such as exist in a three temperature converter, extended lifetimes appear possible. The concept of using cesium, absorbed on the internal surfaces of the device as a means of cesium replenishment, was verified. C.T.C.

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; protective clothing and equipment; physiological and psychological factors. For related information see also: 05 Biotechnology.

N65-31375*# National Aeronautics and Space Administration, Washington, D. C.
EFFECTS OF IONIZING RADIATION AND OF DYNAMIC FACTORS ON THE FUNCTIONS OF THE CENTRAL NERVOUS SYSTEM—PROBLEMS OF SPACE PHYSIOLOGY
N. N. Livshits, ed. Aug. 1965 189 p refs Transl. into ENGLISH from "Vliyaniye Ioniziruyushchikh Izlucheniy i Dinamicheskikh Faktorov na Funktsii Tsentral'noy Nervnoy Sistemy; Voprosy Kosmicheskoy Fiziologii" Moscow, Izd. Nauka, 1964
(NASA-TT-F-354) CFSTI: HC $5.00/MF $1.25 CSCL 06R

CONTENTS:

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2. EFFECT OF RADIAL ACCELERATION ON VENOUS FLOW IN THE CEREBRAL BLOOD VESSELS OF RABBITS V. Ya. Klimovitskiy p 24–36 (See N65-31377 20-04)

3. EFFECT OF PROLONGED ACCELERATION ON THE GROWTH OF THE ORGANISM AND ON THE FUNCTIONING OF SEVERAL OF ITS SYSTEMS A. A. Gyurdzhian, Z. I. Apanasenko, V. I. Baranov, M. A. Kuznetsova, and L. A. Radkevich p 37–48 (See N65-31378 20-04)

4. EFFECT OF VIBRATION ON THE NERVOUS SYSTEM L. D. Luk'yanova p 49–62 ref (See N65-31379 20-04)
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6. EFFECT OF ACUTE WHOLE-BODY γ-IRRADIATION ON VESTIBULAR FUNCTION IN GUINEA PIGS Z. I. Apanasenko p 72–78 (See N65-31381 20-04)
7. COMBINED EFFECTS OF VIBRATION AND ACUTE IRRADIATION ON VESTIBULAR FUNCTION IN GUINEA PIGS Z. I. Apanasenko p 79–87 (See N65-31382 20-04)
8. EFFECT OF ACUTE WHOLE-BODY γ-IRRADIATION ON EXCITABILITY OF THE SPINAL REFLEX ARC M. A. Kuznetsova p 88–96 (See N65-31383 20-04)
9. EFFECT OF GENERAL VERTICAL VIBRATION ON SPINAL REFLEX ARC FUNCTION M. A. Kuznetsova p 97–104 (See N65-31384 20-04)
10. COMBINED EFFECTS OF VIBRATION AND IONIZING RADIATION ON THE FUNCTIONAL STATE OF THE SPINAL REFLEX ARC M. A. Kuznetsova p 105–110 (See N65-31385 20-04)
11. EFFECT OF GENERAL REPEATED VIBRATION ON OXYGEN TENSION IN THE BRAIN OF RATS L. D. Luk'yanova p 111–125 (See N65-31386 20-04)
12. COMBINED EFFECT OF GENERAL VERTICAL VIBRATION AND IRRADIATION ON THE OXIDATIVE PROCESSES IN THE BRAIN OF RATS L. D. Luk'yanova p 126–139 ref (See N65-31387 20-04)
13. THE EFFECT OF GENERAL VERTICAL VIBRATION AND X-RAYS ON THE NUCLEI OF BONE MARROW CELLS IN MAMMALS Yu. S. Demin p 140–159 (See N65-31388 20-04)
14. REFERENCES p 160–190

N65-31376* National Aeronautics and Space Administration, Washington, D. C.

COMBINED EFFECTS OF IONIZING RADIATION AND OTHER FACTORS

N. N. Livshits *In its* Effects of Ionizing Radiation and of Dyn. Factors on the Functions of the Central Nervous System—Probl. of Space Physiol. Aug. 1965 p 1–23 (See N65-31375 20-04) CFSTI: HC $5.00/MF $1.25

The literature on combined effects of ionizing radiation and nonradiation factors on mammalian organisms is reviewed. The problem of the mechanism of organism response to combined factors is discussed. Published results of experimental investigations of combined effect of vibration and ionizing radiation on some animal organism functions are discussed. These studies are compared with literary data, and the mechanism of higher animal reactions to combined effect of vibration and ionizing radiations is considered. A suggestion is expressed that in responses to vibration and irradiation effects side by side with the mechanisms described in literature, parabiotic processes in the nervous system may be of great importance. Author

N65-31377* National Aeronautics and Space Administration, Washington, D. C.

EFFECT OF RADIAL ACCELERATION ON VENOUS FLOW IN THE CEREBRAL BLOOD VESSELS OF RABBITS

V. Ya. Klimovitskiy *In its* Effects of Ionizing Radiation and of Dyn. Factors on the Functions of the Central Nervous System—Probl. of Space Physiol. Aug. 1965 p 24–36 (See N65-31375 20-04) CFSTI: HC $5.00/MF $1.25

Blood flow in cerebral veins of 9 rabbits was studied by means of a thermistor coupled with a heater. Animals were exposed to accelerations of 5–10 g on the centrifuge in the direction "head-pelvis." Exposure for 30 sec was repeated 5–10 times with 30 min intervals for several days. Venous blood flow increased at the beginning of the centrifugation, and sharply decreased at the end. The phenomenon of successive reaction intensification during repeated exposure was recorded. After the centrifuge was stopped, the increase of venous blood flow during 3–5 min and a prolonged decrease afterward were observed. After 3–4 days some adaptation to the acceleration effect could be observed. It was found that the reaction of venous blood flow was determined by the interaction of 2 factors: passive mechanical blood displacement and physiological compensation. Author

N65-31378* National Aeronautics and Space Administration, Washington, D. C.

EFFECT OF PROLONGED ACCELERATION ON THE GROWTH OF THE ORGANISM AND ON THE FUNCTIONING OF SEVERAL OF ITS SYSTEMS

A. A. Gyurdzhian, Z. I. Apanasenko, V. I. Baranov, M. A. Kuznetsova, and L. A. Radkevich *In its* Effects of Ionizing Radiation and of Dyn. Factors on the Functions of the Central Nervous System—Probl. of Space Physiol. Aug. 1965 p 37–48 (See N65-31375 20-04) CFSTI: HC $5.00/MF $1.25

Rats attaining the age of 2–3 days were exposed to acceleration of 2–3 g 5–6 hours daily during 2–3 months. The weight of experimental rats was smaller than that of the control. Special experiments showed that unfavorable conditions of food intake during rotation were not the single cause of the low weight of experimental animals. Motor activity in experimental rats during special test rotation was higher than in the control. Mortality under the action of lethal acceleration was the same in both groups. No difference between viability of experimental and control rats was observed. In experimental rats the excitability of equilibrium organ was reduced. Bioelectric reaction of extremity muscles to adequate stimulation of vestibular apparatus was lower, the latency of reaction was longer and the duration of aftereffect was shorter. Bioelectric activity of skeletal muscles at rest in experimental rats was lower. The latency of unconditioned defensive reflexes to a weak stimulus in experimental rats was longer than in the control; the latency of the reflex to medium and strong stimuli exhibited a tendency to shortening. Author

N65-31379* National Aeronautics and Space Administration, Washington, D. C.

EFFECT OF VIBRATION ON THE NERVOUS SYSTEM

L. D. Luk'yanova *In its* Effects of Ionizing Radiation and of Dyn. Factors on the Functions of the Central Nervous System—Probl. of Space Physiol. Aug. 1965 p 49–62 ref (See N65-31375 20-04) CFSTI: HC $5.00/MF $1.25

Based on the literature and personal investigations, the author shows the effect of local and total, single and chronic vibration on the state of the peripheral and central nervous systems. The problem of the mechanism of vibration effect on the living body is considered. A generalizing scheme of vibration influence on the nervous system is suggested. This scheme reveals the possibility of formation of the regions of steady excitation in the spinal cord and the higher parts of the central nervous system. Author

N65-31380* National Aeronautics and Space Administration, Washington, D. C.

EFFECT OF GENERAL VERTICAL VIBRATION ON VESTIBULAR FUNCTION IN GUINEA PIGS

Z. I. Apanasenko *In its* Effects of Ionizing Radiation and of Dyn. Factors on the Functions of the Central Nervous System—Probl. of Space Physiol. Aug. 1965 p 63–71 (See N65-31375 20-04) CFSTI: HC $5.00/MF $1.25

The influence of total vertical vibration on the functional state of the equilibrium organ was studied. Electromyograms of the group of antigravitation muscles of guinea pig hind extremities at relative rest and at adequate stimulation of equilibrium organ were recorded. After vibration a statistically significant increase of spontaneous electrical activity of investigated muscles at relative rest was observed. Electromyographic response to adequate stimulation of the equilibrium organ was activated: latency of this reaction decreased, while after-effect prolonged it. These effects were observed 7–12 days after vibration. General state of the animal and the cells of the peripheral blood were not subjected to statistically significant changes under the action of vibration. Author

N65-31381* National Aeronautics and Space Administration, Washington, D. C.

EFFECT OF ACUTE WHOLE-BODY γ-IRRADIATION ON VESTIBULAR FUNCTION IN GUINEA PIGS

Z. I. Apanasenko *In its* Effects of Ionizing Radiation and of Dyn. Factors on the Functions of the Central Nervous System— Probl. of Space Physiol. Aug. 1965 p 72–78 (See N65-31375 20-04) CFSTI: HC $5.00/MF $1.25

The change in functions of the equilibrium organ of guinea pigs totally irradiated with γ-rays Co^{60} with 500 r, at a dose rate of 261 r/min, was studied. Electromyograms of the group of antigravitational muscles in hind legs of guinea pigs at relative rest and at adequate stimulation of equilibrium organ were recorded. After irradiation a distinct decrease of spontaneous electrical activity of the investigated muscles at relative rest and the change of bioelectric reaction of these muscles to the adequate stimulation of the equilibrium organ were observed. This reaction becomes less regular and often is pathologically increased; its latency increases sharply, while aftereffect is shortened. The clinical state of the animals was in conformity with the normal course of acute radiation sickness with lethal outcome on the 9th–14th day. Author

N65-31382* National Aeronautics and Space Administration, Washington, D. C.

COMBINED EFFECTS OF VIBRATION AND ACUTE IRRADIATION ON VESTIBULAR FUNCTION IN GUINEA PIGS

Z. I. Apanasenko *In its* Effects of Ionizing Radiation and of Dyn. Factors on the Functions of the Central Nervous System— Probl. of Space Physiol. Aug. 1965 p 79–87 (See N65-31375 20-04) CFSTI: HC $5.00/MF $1.25

The complex effect of simultaneously or consecutively applied vibration and acute irradiation with a dose of 500 r on the functions of the equilibrium organ was studied. Electromyograms of the group of antigravitational muscles of guinea pig hind extremities at relative rest and at adequate stimulation of equilibrium organ were recorded. The change in radiation response of the organism under vibration effect was recorded. By the number of blood cells, weight dynamics, general clinical state and animal survival, the author found no authentic differences between complex effect and single irradiation. Author

N65-31383* National Aeronautics and Space Administration, Washington, D. C.

EFFECT OF ACUTE WHOLE-BODY γ-IRRADIATION ON EXCITABILITY OF THE SPINAL REFLEX ARC

M. A. Kuznetsova *In its* Effects of Ionizing Radiation and of Dyn. Factors on the Functions of the Central Nervous System— Probl. of Space Physiol. Aug. 1965 p 88–96 (See N65-31375 20-04) CFSTI: HC $5.00/MF $1.25

Total γ-irradiation with 500 r caused an increase of the latent period of motor defense reflexes in guinea pig extremities. At the same time, normal relation between stimulation intensity and the strength of response was preserved. The excitability threshold of the reaction increased in one group of the animals after irradiation, and decreased in the other group, but these changes were not statistically significant. Correlation between the dynamics of changes in excitability thresholds and of latency was not observed. Author

N65-31384* National Aeronautics and Space Administration, Washington, D. C.

EFFECT OF GENERAL VERTICAL VIBRATION ON SPINAL REFLEX ARC FUNCTION

M. A. Kuznetsova *In its* Effects of Ionizing Radiation and of Dyn. Factors on the Functions of the Central Nervous System— Probl. of Space Physiol. Aug. 1965 p 97–104 (See N65-31375 20-04) CFSTI: HC $5.00/MF $1.25

Total vertical vibration of 70 cps, amplitude 0.4 mm and duration of 15 min was applied twice with a 24-hour interval between exposures. It caused, not sharp, but statistically significant increase of the excitability threshold of motor defense reflex in guinea pig extremities. The latency in one group of the animals increased and in the other group decreased. In all animals, responses to stimulators of weak and high intensity were equalized. This fact indicates development of parabiotic phenomena in the investigated reflex arc. Author

N65-31385* National Aeronautics and Space Administration, Washington, D. C.

COMBINED EFFECTS OF VIBRATION AND IONIZING RADIATION ON THE FUNCTIONAL STATE OF THE SPINEL REFLEX ARC

M. A. Kuznetsova *In its* Effects of Ionizing Radiation and of Dyn. Factors on the Functions of the Central Nervous System— Probl. of Space Physiol. Aug. 1965 p 105–110 (See N65-31375 20-04) CFSTI: HC $5.00/MF $1.25

The complex effect of total vertical vibration and 500 r γ-irradiation on the excitability threshold and the latency of motor defense reflex in guinea pig hind extremities were studied. Total vertical vibration of 70 cps, 0.4 mm amplitude and 15 min duration was applied twice: 30–40 min before and 24 hours after irradiation. In response to complex action of these factors, some properties of separate effects of each factor were combined. In one part of the animals vibration effects predominated, while in the other part irradiation prevailed. According to the reactions of some functions, the results of the complex effect took an intermediate position between vibration and radiation effects. Author

N65-31386* National Aeronautics and Space Administration, Washington, D. C.

EFFECT OF GENERAL REPEATED VIBRATION ON OXYGEN TENSION IN THE BRAIN OF RATS

L. D. Luk'yanova *In its* Effects of Ionizing Radiation and of Dyn. Factors on the Functions of the Central Nervous System— Probl. of Space Physiol. Aug. 1965 p 111–125 (See N65-31375 20-04) CFSTI: HC $5.00/MF $1.25

Single vibration of animals (70 cps) caused the appearance of 3 successively developing phases: (a) increase of oxygen consumption by cerebral tissue, (b) decrease of its consumption, (c) restoration period. Repeated vibrations strengthened the changes in each phase. Adaptation phenomenon was not observed. Changes in the level of oxidative processes induced by vibration are not identical in different parts of the brain. Vibration causes the decrease of lymphocytes during the first hour, followed by leukocytosis. The study shows that the changes in oxygen tension and in the level of its consumption by cerebral tissue reflect a specific state of nerve tissue, that develops in response to vibration effect. Author

N65-31387* National Aeronautics and Space Administration, Washington, D. C.
COMBINED EFFECT OF GENERAL VERTICAL VIBRATION AND IRRADIATION ON THE OXIDATIVE PROCESSES IN THE BRAIN OF RATS
L. D. Luk'yanova *In its* Effects of Ionizing Radiation and of Dyn. Factors on the Functions of the Central Nervous System—Probl. of Space Physiol. Aug. 1965 p 126–139 ref (See N65-31375 20-04) CFSTI: HC $5.00/MF $1.25

Changes of oxidative processes in cerebral tissues of animals (rats) exposed to vibration with subsequent irradiation proceeded differently than those of animals subjected to each effect separately. Summation effect induced by vibration was not observed. Survival of animals in the second case was significantly higher than that in the group of irradiated animals. A parallelism between the functional state of nerve centers of irradiated animals and oxidative processes in the brain was observed. The mechanism of the combined effects of vibration and irradiation on oxygen consumption by cerebral tissue is discussed. Author

N65-31388* National Aeronautics and Space Administration, Washington, D. C.
THE EFFECT OF GENERAL VERTICAL VIBRATION AND X-RAYS ON THE NUCLEI OF BONE MARROW CELLS IN MAMMALS
Yu. S. Demin *In its* Effects of Ionizing Radiation and of Dyn. Factors on the Functions of the Central Nervous System—Probl. of Space Physiol. Aug. 1965 p 140–159 (See N65-31375 20-04) CFSTI: HC $5.00/MF $1.25

The paper presents the results of the investigations of the effect of vibration (60–70 cps), of the irradiation with doses of 50–100 r of X-rays and of the combined effect of vibration and irradiation on the cells of marrow of mice. Vibration of animals causes an increase of disturbed mitosis due to a higher rate of chromosome cohesion. Vibration preceding irradiation does not increase the rate. Some decrease of rate of chromosome aberrations and increase of rate of chromosome cohesion was found when the combined effect of both factors was studied. The rate of disturbed mitosis in the marrow cells of mice analyzed was higher than that in control for as long as ten days. Author

N65-31420# Joint Publications Research Service, Washington, D. C.
CONTROL MECHANISMS OF DNA BIOSYNTHESIS
I. I. Filippovich 17 Aug. 1965 18 p refs Transl. into ENGLISH from Usp. Sovrem. Biol. (Moscow), v. 58, no. 1 (4), Jul.–Aug. 1964 p 22–32
(JPRS-31578; TT-65-32074) CFSTI: $1.00

Five chemical processes which are individually capable of regulating the entire biosynthesis of deoxy-ribonucleic acid (DNA) are discussed. These processes are biosynthesis of monophosphates of the purine and pyrimidine ribosides; reduction of ribotides into corresponding deoxy-ribotides, and deamination of deoxy-cytidine-monophosphate with formation of deoxy-uridine-monophosphate; formation of thymidine-triphosphate; polymerization of the triphosphates of nucleosides with formation of DNA; and disintegration of the DNA-primer into two polynucleotide chains. J.M.D.

N65-31421# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MICROBIOLOGY Selected Articles
18 May 1965 26 p refs Transl. into ENGLISH from Mikrobiologiya (Moscow), v. 33, no. 3, 1964 p 472–476, 508–515 (FTD-TT-65-66/1+2; AD-617161)

CONTENTS:
1. EFFECT OF BLUE-GREEN ALGAE ON THE DEVELOPMENT OF MICROORGANISMS IN THE SOIL G. M. Perminova p 1–9 refs (See N65-31422 20-04)
2. CULTIVATION OF GREEN PLANKTON ALGAE ON SEWAGE G. G. Vinberg p 10–22 refs (See N65-31423 20-04)

N65-31422 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF BLUE-GREEN ALGAE ON THE DEVELOPMENT OF MICROORGANISMS IN THE SOIL
G. N. Perminova *In its* Microbiol. 18 May 1965 p 1–9 refs (See N65-31421 20-04)

Experiments using soddy-podzolic soils from various USSR regions showed that the introduction of blue-green algae into the soil increases the number of aerobic and anaerobic nitrogen-fixing microorganisms. It was also found that blue-green algae in soils characteristic of temperate zones form nitrogen-fixing complexes. J.M.D.

N65-31423 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CULTIVATION OF GREEN PLANKTON ALGAE ON SEWAGE
G. G. Vinberg *In its* Microbiol. 18 May 1965 p 10–22 refs (See N65-31421 20-04)

Laboratory experiments on the growth of algae in sewage are reported which are of interest with respect to the question of whether city sewage water can be self-purified in biological ponds. Various algae varieties were introduced into flasks containing city sewage water, in the presence or absence of air, and culture growth and chemical determinations were made over a period of several weeks. It was found that the dry weight of algae reached a maximum after six to eight days, and remained at that level until the end of the experiments. The amount of ammonium–nitrogen compound appeared to drop rapidly from the outset of the tests. In all cases the active reaction of the medium gradually shifted to the alkali side, reaching Ph values as high as 12.5. The basic factor that limited the extent of algae growth was the amount of carbon available in the sewage water. J.M.D.

N65-31514# Rutgers Univ., New Brunswick, N. J. Dept. of Physiology and Biochemistry.
[PHYSIOLOGICAL AND BIOCHEMICAL STUDIES OF CATS] Formal Progress Report
Harry M. Frankel 14 Jul. 1965 5 p
(Contract AF 41(609)-2635)
(AD-468457)

Measurements of mean arterial (MAP) and right atrial (RAP) pressures in 10 cats during progressive hyperthermia showed effective cardiac output at temperatures greater than 42°C although MAP was decreasing. A negative RAP at temperatures approaching 44°C led to the conclusion, that the decreased MAP was induced by inadequate venous return. A double balloon catheter for collecting of hepatic vein blood from the inferior vena cava was successfully placed in six cats. Arterial blood ketones and β-hydroxybutyrate were also determined during progressive hyperthermia, but no clear pattern of change in ketone concentration was observed. Total plasma lipids and plasma free fatty acid concentrations decreased consistently with increase in temperatures. G.G.

N65-31520# Joint Publications Research Service, Washington, D. C.

CHEMICAL TRANSMISSION OF NEURAL EXCITATIONS

A. V. Kibyakov 17 Aug. 1965 13 p Transl. into ENGLISH from "Khimicheskaya Peredacha Nervnogo Vozbuzhdeniya" Moscow, Acad. of Sciences USSR, 1964 p 177–185, 207–208

(JPRS-31577; TT-65-32073) CFSTI: $1.00

The conclusions and table of contents are given for a book on the subject of chemical transmission of neutral excitations. Among the conclusions were the following: (1) Removal of the medullary substance of the adrenal glands and certain accessory chromaffin paraganglia in animals affects the action of the sympathetic nervous system. Its basic disruption is the result of a significant decrease in the quantity of sympathin discharged at the adrenergic nerve endings at the time of their excitation. (2) Extirpation of most of the pancreas in animals leads to a noticeable disruption of the activity of cholinergic innervation. The basis of this disruption is the significant decrease in the quantity of acetylcholine discharged at the cholinergic nerve endings during their excitation. (3) The development of tonic contraction of smooth muscle is accompanied by noticeable reconstruction of its contractile apparatus. (4) It is observed that the influence of removing the medullary substance of the adrenal glands on the function of the adrenergic nervous system has a temporary, transitional character.

E.E.B.

N65-31522# Joint Publications Research Service, Washington, D. C.

BIOLOGICAL MEASUREMENTS IN SPACE

K. B. Karandeyev, ed. 24 Aug. 1965 40 p refs Transl. into ENGLISH of the book "Avtomaticheskiy Kontrol' i Metody Elektricheskikh Izmereniy, Tom II: Teoriya Izmeritel'nykh Informatsionnykh Sistem" Novosibirsk, Acad. of Sci. USSR, Siberian Dept., 1964

(JPRS-31679; TT-65-32174) CFSTI: $2.00

CONTENTS:

1. EMPLOYMENT OF A DIGITAL COMPUTER FOR AUTOMATIC MONITORING OF THE CONDITION OF A COSMONAUT AND LIFE SUPPORT SYSTEMS R. M. Bayevskiy, V. V. Bogdanov, A. M. Zhdanov, L. A. Kazar'yan, and V. I. Yazdovskiy p 1–9 refs

2. INFORMATION MEASURING SYSTEMS IN SPACE BIOLOGY R. M. Bayevskiy, A. D. Voskresenskiy, O. G. Gazenko, A. D. Yegorov, N. A. Chekhonadskiy et al p 10–18 refs

3. SENSORS FOR PHYSIOLOGICAL INVESTIGATIONS DURING SPACE FLIGHT I. T. Akulinichev, R. M. Bayevskiy, O. G. Gazenko, K. P. Zazykin, I. S. Shadrintsev p 19–28 refs

4. THE DESIGN OF AUTOMATIC DEVICES FOR ANALYSIS OF BALLISTOCARDIOGRAMS K. P. Buteyko, N. G. Buryy, N. V. Vas'kova, A. K. Romanov, and I. I. Smirnova p 29–37 refs

N65-31531# Joint Publications Research Service, Washington, D. C.

INHIBITION OF EVOKED ACTIVITY OF NEURONS OF THE CEREBRAL CORTEX DURING THE ACTION OF A SOUND STIMULUS

V. G. Skrebitskiy and L. L. Voronin 9 Aug. 1965 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 160, no. 4, 1965 p 972–975

(JPRS-31467; TT-65-31963) CFSTI: $1.00

Experiments were conducted on anesthetized rabbits to determine the neuronal basis of conditioned reflex activity inhibition induced by the sudden introduction of an outside stimulus. Observed were changes in response to flashes of light by neurons of the visual cortex under the influence of a sound stimulus. Seven rabbits were used and data derived from recordings of the extracellular activity of 100 individual neurons. Results showed that 48% of the recorded neurons did not respond to flashing light, and that 55 did respond. Also a significant number of neurons of the visual cortex (45 of 100) reacted to the introduction of sound stimuli. Presented are numerical data on the changes in neuronal activity during light and sound stimuli; and data on the effects of sound on the discharges evoked by light. The neurons responding best to light were those with low basal activity. Speculation is made concerning the importance of intracellular recording and the morphological identification of neurons of the cortex and subcortical structures.

S.C.W.

N65-31535# Joint Publications Research Service, Washington, D. C.

SOVIET STUDIES IN MOLECULAR BIOLOGY, GENETICS, AND STRESS

18 Aug. 1965 57 p Transl. into ENGLISH from Priroda (Moscow), no. 5, 1965 p 17–20, 24–25, 27–32, 51–55

(JPRS-31599; TT-65-32094) CFSTI: $3.00

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1. PROBLEMS OF MOLECULAR BIOLOGY. INVESTIGATION OF ANIMATED ON UNANIMATED OBJECTS V. A. Engel'gardt p 1–4

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8. HOW PROTEINS ARE FORMED L. L. Kiselev p 23–32

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15. STRESS: EXCESSIVE EXERTION OF AN ORGANISM—CAUSES, AND MEANS OF PREVENTION M. M. Reydler p 46–54

N65-31536# Joint Publications Research Service, Washington, D. C.

STUDIES IN GENETICS

M. Ye. Lobashev, ed. 11 Aug. 1965 117 p refs Transl. into ENGLISH from Issled. po Genet. (Leningrad), no. 2, 1964 p 3–20, 46–85, 125–133

(JPRS-31514; TT-65-32010) CFSTI: $4.00

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1. GENETICS OF THE BEHAVIOR (NERVOUS ACTIVITY) OF ANIMALS—MATERIALS ON THE ANALYSIS OF INHERITANCE OF THE EXCITABILITY OF MOTOR NERVE FIBERS G. D. Golovachev p 1–7 refs

2. STUDIES ON THE INHERITANCE OF PROPERTIES OF HIGHER NERVOUS ACTIVITY IN INTERSPECIFIC AND INTERBREED RECIPROCAL CROSSES V. V. Ponomarenko, V. G. Marshin, and M. Ye. Lobashev p 8–28 refs

3. INDUCED MUTATION PROCESS—THE EFFECT OF HIGH TEMPERATURE AFTER IRRADIATION ON THE FREQUENCY OF OCCURRENCE OF LETHAL MUTATIONS AND CHROMOSOMAL BREAKS K. V. Vatty and I. M. Janoosh p 29–43 refs

4. NON-DIVERGENCE OF CHROMOSOMES UNDER THE INFLUENCE OF X-RAYS OF VARIED HARDNESS AND INTENSITY M. M. Tikhomirova p 44–58 refs

5. A COMPARATIVE STUDY OF THE RESULT OF RADIATION AFTER-EFFECTS ON CHROMOSOMAL NON-DIVERGENCE M. M. Tikhomirova, S. Ye. Dubrova, and I. M. Janoosh p 59–64 refs

6. A COMPARATIVE STUDY OF THE MUTAGENIC ACTION OF DIFFERENT TYPES OF RADIATION AND ETHYLENEIMINE ON THE ALGA CHLORELLA V. I. Khropova, K. V. Kvitko, and I. A. Zakharov p 65–76 refs

7. COMPARISON OF THE SPECIFICITY OF THE ACTION OF ULTRA-VIOLET RAYS AND X-RAYS ON THE MUTABILITY OF YEAST S. G. Inge-Vechtomov and S. A. Kozhin p 77–91 refs

8. THE DEVELOPMENT OF MALE AND FEMALE GAMETOPHYTES OF ARABIDOPSIS THALIANA (L) HEYHN T. F. Polyakova p 92–104 refs

9. ASCOSPORE ISOLATION OF YEAST FOR GENETIC ANALYSIS WITHOUT A MICROMANIPULATOR I. A. Zakharov and S. G. Inge-Vechtomov p 105–113 refs

N65-31620# School of Aerospace Medicine, Brooks AFB, Tex.

HEART RATE PATTERNS OBSERVED IN MEDICAL MONITORING Technical Documentary Report, Jan. 1961–Dec. 1964

David G. Simons and Robert L. Johnson May 1965 22 p refs (SAM-TR-65-26; AD-467734)

The study included heart rate records from several hundred individuals under a wide variety of aerospace flight stress situations including sleep, quiet wakefulness, clinical stress testing, simulated aircraft flight, and F-100 aircraft flight. Automated beat-by-beat heart rate analysis recorded at 1 mm. per second paper speed clearly demonstrated a variety of heart rate patterns. Base heart rate values which reflected homeostatic levels were distinguished from heart rate reflex activity identified as transient disruptions of homeostasis. Reflex patterns were divided into respiratory heart rate and slow wave heart rate reflex activity. Three forms of slow waves were identified: cardioaccelerator, balanced, and cardiodecelerator. The discussion included physiologica mechanisms contributing to the observed heart rate reflex patterns. Author

N65-31693# Cincinnati Univ., Ohio. Coll. of Medicine.

METABOLIC CHANGES IN HUMANS FOLLOWING TOTAL BODY IRRADIATION Annual Report, 1 May 1963–28 Feb. 1964

Eugene L. Saenger, Ben I. Friedman, James G. Kereiakes, and Harold Perry [1964] 30 p refs

(Contract DA-49-146-XZ-029)

(DASA-1633; AD-464277)

Information is being investigated to estimate combat effectiveness of troops and to develop methods of diagnosis, prognosis, prophylaxis and treatment of radiation injury. At the present time parameters of active investigation are clinical findings, hematologic effects, profile scores, miscellaneous laboratory tests, deoxycytidine excretion in the urine, xanthurenic acid excretion in the urine, chromosome changes in leucocytes, immunologic studies and the use of autologous bone marrow. Six patients were given from 149r to 231r (100–150 rad) total body irradiation from a Co^{60} source. Only one of the patients had prodromal nausea and vomiting with nausea lasting 48 hours. The lowest hematologic values were found 25 to 35 days after irradiation. Deoxycytidine was found in increased amounts in the urine from patients after total body irradiation. In rats much larger amounts were found in the urine after 500r and 800r whole body irradiation than after lesser doses. Studies indicate there may be an immunologic post irradiation alteration in human gamma globulin antigenicity. Combat effectiveness would be relatively maintained with an exposure up to 200 rad, though a second exposure would result in significant troop ineffectiveness. Author

N65-31712# Joint Publications Research Service, Washington, D. C.

A GROWTH EQUATION SYSTEM AND CERTAIN OTHER SYSTEMS MODELLING BIOLOGICAL OBJECTS

S. I. Anisimov 23 Aug. 1965 4 p refs Transl. into ENGLISH from Biofizika (Moscow), v. 10, no. 2, 1965

(JPRS-31663; TT-65-32158) CFSTI: $1.00

Restrictions on differential equations which are necessary in order to use dynamic modelling to describe biological systems are discussed briefly. J.M.D.

N65-31717# Joint Publications Research Service, Washington, D. C.

MEDICAL RESEARCH AND EQUIPMENT

9 Aug. 1965 9 p Transl. into ENGLISH from Med. Gazeta (USSR), 6 Apr. 1965

(JPRS-31463; TT-65-31959) CFSTI: $1.00

The problem of human acclimatization to hot climate conditions is discussed. Investigations conducted in Central Asia disclosed that a hot climate, eliciting changes in physiological reactions, affects human pathology. A comparative analysis revealed that the incidence of cerebrovascular affections and myocardial infarct among the inhabitants of Ashkhabad was frequently doubled as compared to the inhabitants of Ufa. It was established that the hot climate induces asthenia, apathy, and loss of appetite which complicates the course of the postsurgical period; shifts in the indices of hemodynamics, and aqueous-saline metabolism were also noted in the postsurgical patients. It was concluded that biotics, particularly salts of copper, molybdenum, zinc, and mercury and iodine, stimulate the phagocyte activity of the leukocytes and metabolism. These facts indicated the possibilities of active interference in the acclimatization processes. R.W.H.

N65-31787# School of Aerospace Medicine, Brooks AFB, Tex.

FLYING STRESS IN RELATION TO FLYING PROFICIENCY

Henry B. Hale, John C. Duffy, Jmes P. Ellis, Jr., and Edgar W. Williams Dec. 1964 15 p refs Submitted for Publication (SAM-TR-64-88; AD-458843)

Postflight urinary determinations were employed for the purpose of evaluating flight stress in 10 pilots who were practicing bombing-strafing maneuvers. Tests were conducted in daytime and at night. Control data were obtained on nonflying days. Urinary determinations included norepinephrine, epinephrine, 17-hydroxycorticosteroids, creatinine, urea, uric acid, phosphate, potassium, and sodium. By the use of this battery of determinations, it was possible to appraise flight-sensitivity in sympathoadrenal, adrenocortical, and metabolic activities. The results give good leads for further research and suggest that flying proficiency is high when endocrinemetabolic displacement (physiologic cost) is low. These observations also indicate that stress reactions to flight conform to the General Adaptation Syndrome pattern. Author

N65-31798# California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology.
[BIOCHEMISTRY, RADIOBIOLOGY, PHARMACOLOGY, TOXICOLOGY, AND NUCLEAR MEDICINE] Semiannual Progress Report, Period Ending Jun. 30, 1965
[1965] 129 p refs
(Contract AT(04-1)-GEN-12)
(UCLA-12-541)

A list of publications and reports is presented in the areas of Biochemistry, Radiobiology, Pharmacology and Toxicology, Nuclear Medicine, Biophysics, and Environmental Radiation.
R.W.H.

N65-31833# Polytechnic Inst. of Brooklyn, N. Y.
PSEUDO-RANDOM DOT SCAN TELEVISION SYSTEMS
Sid Deutsch [1964] 40 p refs
(Contract AF 19(628)-3815; Grant NSF GP-2384)
(AD-463037)

The principal psychophysical requirements of the human eye are satisfied by a television frame frequency of 1 or 2 cycles/sec. To avoid flicker with such low frame rates, a pseudo-random dot scan is employed in conjunction with long-persistence phosphors. Experiments show that 15% dot flicker is tolerable. Ten systems are discussed, including a two-mission-element picture with 4 mc/sec bandwidth; tape recording at 15 inches/sec; the continuous relaying of satellite pictures; short-wave transmission; phonevision; and very low frame rate applications that use a scan conversion tube.
Author

N65-31857# Joint Publications Research Service, Washington, D. C.
CYBERNETICS IN MEDICINE
A. A. Vishnevskiy 25 Aug. 1965 16 p Transl. into ENGLISH from Priroda (Moscow), no. 6, 1965 p 24–34
(JPRS-31712; TT-65-32207) CFSTI: $1.00

Presented is an analysis of the interrelationships and parallel development of cybernetics and medicines. Considered are techniques employed by cybernetic systems, and medical diagnostic techniques. Cited are classical examples which illustrate the effectiveness of diagnostic techniques used in both areas as in the treatment of congenital heart defects and anomalies of the cardiovascular system. Discussed are medical memory diagnosis, logical processes of machine diagnosis, machine prognosis of disease, and an electronic medical archive.
R.W.H.

N65-31864# Air Force Systems Command, Wright-Patterson AFB, Ohio. Biomedical Lab.
DETERMINATION OF HYDRAZINE AND 1-METHYLHYDRAZINE IN BLOOD SERUM Technical Documentary Report, Jun. 1962–Aug. 1963
Barbara A. Reynolds and Anthony A. Thomas Apr. 1964 14 p refs
(AMRL-TDR-64-24; AD-441231)

A simple procedure is described for measuring microgram amounts of hydrazine in the blood serum of rats. The procedure, with a minor modification, can be used for measuring microgram amounts of 1-methylhydrazine. The report presents calibration ranges of 0.5–5.0 μg/ml and 0.5–10.0 μg/ml of hydrazine and 1-methylhydrazine, respectively. Data are presented on the dose–blood-level relationship of hydrazine and 1-methylhydrazine in rats following intraperitoneal injection. Minimum detectable dose levels were 0.6 mg/kg and 3.0 mg/kg of hydrazine and 1-methylhydrazine, respectively.
Author

N65-31915# Laboratoires du Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).
CELLULAR AND BIOCHEMICAL RADIOBIOLOGY Final Report, 1964 [RADIOBIOLOGIE CELLULAIRE ET BIOCHIMIQUE RAPPORT FINAL, 1964]
Brussels, EURATOM, 1965 25 p refs In FRENCH; ENGLISH summary
(Contract EURATOM-014-62-1 BIOB)
(EUR-2201.f) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 40 Belg. Fr.

The authors carried out the following research: (1) Using microelectrophoresis in agar, immuno-electrophoresis and incorporation of amino-acids, on the protein changes in the serum and various tissues of mice irradiated with a lethal and sublethal dose of X-rays. (2) On the permeability of cellular and tissue membranes to macromolecules and the influence thereon of radiations. These studies were carried out on both vegetable and animal organs (genital organs and hyperplasia, normal and cancerous tissues, embryo tissues). (3) On the intracellular distribution of the cytoplasmic hydrolases; the relation between the activity of acid DNAse and growth; the inhibition of DNA-polymerase by rat-liver microsomes; the thymidine phosphokinases; and the isotopic effect of tritium.
Author

N65-31931# Library of Congress, Washington, D. C. Aerospace Technology Div.
FUNCTIONS OF THE ORGANISM UNDER CONDITIONS OF AN ALTERED GAS ENVIRONMENT
10 Jun. 1965 30 p refs *Its* A.T.D. Press, Vol. 3, No. 240
(AD-618421)

Twenty seven abstracts are presented of selected articles on respiratory physiology from Soviet literature. Emphasis is placed on problems connected with increased barometric pressure. Several articles deal with the theoretical aspects of decompression sickness. Other articles are concerned with the problem of the toxic effects of oxygen, particularly those functional changes which occur when the effect of oxygen is not accompanied by convulsions. Also, the mechanical effects of pressure during abrupt decompressions, of rarefied atmospheres on the central nervous system, of pressurized respiratory equipment, and of helium utilization in respiratory mixtures are included.
E.E.B.

N65-31958# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension.
SUBJECT INDEX TO EFFECTS OF RADIATION ON THE MAMMALIAN EYE—A LITERATURE SURVEY
Helen L. Ward and William E. Bost Jul. 1964 18 p See also N63-85182
(TID-3912(Index)) CFSTI: $0.50

A subject index of a literature survey dealing with the effects of radiation on the mammalian eye includes headings related to the structure of the eye, diseases of the eye, and various types of radiation.
M.W.R.

N65-32010# Joint Publications Research Service, Washington, D. C.
STANDARDS OF RADIATION SAFETY
Vl. Kalaydzhiev and Iv. Popov 23 Aug. 1965 23 p Transl. into ENGLISH from D'rzhaven Vestn. (Sofia), no. 59, 27 Jun. 1965 p 2–6
(JPRS-31646; TT-65-32141) CFSTI: $1.00

Maximum permissible doses of external and internal irradiation and maximum permissible concentrations of radioactive substances in water and air are discussed, equations for their calculation are presented, and standards are tabulated. These standards of radiation safety were developed on the basis of the standards adopted in 1964 by the member countries of the Council of Mutual Economic Cooperation and compliance by member countries is mandatory.
E.E.B.

N65-32011# Joint Publications Research Service, Washington, D. C.
REPORT OF AN EXPERIMENT ON COLOR PERCEPTION IN BEES
G. A. Mazokhin-Porshnyakov 25 Aug. 1965 11 p refs Transl. into ENGLISH from Priroda (Moscow), no. 6, 1965 p 58–62 (JPRS-31713; TT-65-32208) CFSTI: $1.00

Experiments are described which show that bees possess an adequately developed color vision and that the information derived from this color vision is extensively used in their behavior patterns. It is also observed that insects are capable of making very fine distinctions in radiation intensity. Two radiations can be distinguished to within as little as 0.5 to 1%. Also, insects can with great accuracy visually determine the position of the planes of polarization of polarized light which the human eye cannot do. E.E.B.

N65-32027*# California Univ., Los Angeles. Brain Research Inst.
NEUROPHYSIOLOGICAL CORRELATES OF INFORMATION TRANSACTION AND STORAGE IN BRAIN TISSUE
W. R. Adey [1965] 62 p refs
(Contract NsG-502)
(NASA-CR-64570) CFSTI: HC $3.00/MF $0.75 CSCL 05J

The problem of what constitutes information at the input of cerebral systems, what are its transforms in transactional processes, and what are the bases of storage and recall is considered in the framework of a tri-compartmental cerebral model. Neuronal, neuroglial, and extra cellular activities of the cerebral cellular organization and their interrelationships are discussed. Computed analyses of EEG (electroencephalogram) wave processes indicate the possibility of a stochastic mode of operation in the sensitivity of cortical neurons to recurrent similar patterns of electrical waves. A critical difference between the sensing of physiological processes that relate to transmission and transaction of information, and those relating to information storage was observed. G.G.

N65-32032*# IIT Research Inst., Chicago, Ill.
LIFE IN EXTRATERRESTRIAL ENVIRONMENTS Quarterly Status Report, 15 May–15 Aug. 1965
Charles A. Hagen [1965] 17 p
(Contract NASr-22)
(NASA-CR-64577; IITRI-L6023-2) CFSTI: HC $1.00/MF $0.50 CSCL 06F

Growth response and spore production data on *Bacillus cereus* and *Bacillus subtilis* in a simulated Martian environment for 56 days with different freeze–thaw cycles are presented. As the time of the freeze cycle was extended on the *B. cereus* control group, the growth response was delayed. Compared to the 8-hr freeze cycle, a 16-hr freeze cycle delayed spore germination and vegetative cell growth at least 2 days; sporulation was delayed as much as 4 days. Extension of the freeze cycle to 20 hours delayed spore germination and vegetative cell growth at least 6 days, and sporulation did not occur. The growth response of the *B. subtilis* control group to an increase in the freeze cycle was comparable with that of *B. cereus*. Spore germination and vegetative cell growth were delayed at least 1 day, and sporulation was delayed at least 2 days. Increasing the freeze cycle to 20 hours delayed spore germination and vegetative cell growth at least 3 days, and sporulation did not occur during the 56-day period. Comparison of the growth responses of *B. cereus* and *B. subtilis* showed that *B. subtilis* growth responses were delayed less, and that maximum populations were reached sooner than with *B. cereus*. R.W.H.

N65-32064# California Univ., Berkeley. Lawrence Radiation Lab.
DEPTH DOSE IN TISSUE IRRADIATED BY PROTONS
Palmer G. Steward (M.S. Thesis) 30 Jul. 1964 83 p refs Sponsored in part by NASA
(Contract W-7405-ENG-48)
(UCRL-10980)

A code has been developed for the depth-dose relation in spheres of tissue due to primary protons and to cascade, evaporation, and hydrogen elastically scattered secondary protons. Hydrogen elastically scattered protons are assumed to be emitted in the forward direction, as also, on the basis of Metropolis's calculations, are cascade protons. Evaporation protons are assumed to deposit their dose locally. It is shown that the dose rate at a depth d in a slab due to a normally incident parallel broad beam of protons is the same as the dose rate at the center of a sphere of radius d when an isotropic flux is incident upon the sphere. The depth-dose results are checked by experiments using 730-MeV protons, and compared with Monte Carlo calculations performed at Oak Ridge for 400-MeV protons. The results show that the depth-dose pattern varies widely with proton energy and sphere size. Author

N65-32090*# North Carolina Univ., Durham. Dept. of Botany.
GROWTH OF A PLANT TISSUE CULTURE IN THE GRAVITY-FREE STATE Semiannual Status Report, 1 Oct. 1963–31 Mar. 1964
Ernest A. Ball [1964] 7 p refs
(Grant NsG-524)
(NASA-CR-59238; P-1002) CFSTI: HC $1.00/MF $0.50 CSCL 06C

In the interest of biosatellite applications, the effects of zero gravity on the processes of regeneration and normal growth were studied in laboratory experiments on tobacco stem segments. Growth responses are documented in photographs which show tobacco stem segments with stem plus leaves, apical callus, stem plus leaves and basal roots, roots alone, and numerous buds without basal roots. One of the most remarkable results achieved to date in this program is the growth of the stem pieces in callus-producing culture medium rotated constantly on a klinostat. J.M.D.

N65-32091*# Michigan State Univ., East Lansing. Dept. of Physiology.
[RENAL AND VASCULAR CHANGES PRODUCED BY WEIGHTLESSNESS FOR THE PURPOSE OF DEFINING AND VERIFYING AN EXPERIMENT SUITABLE FOR USE IN A BIOSATELLITE] Progress Report
W. D. Collings 15 Sep. 1964 14 p refs
(Grant NsG-516)
(NASA-CR-58985) CFSTI: HC $1.00/MF $0.50 CSCL 06P

Observations have been made with flow system models to determine reliability, error of measurement, and operational characteristics of specific instruments, such as the electromagnetic flowmeter and its probes, the cardiac output computer, and the dye densitometer for cardiac output. While the flowmeter principle is considered well established, additional studies are recommended for probe implantation and blood vessel reaction. With respect to cardiac output, a study will be made to check the performance of the electromagnetic flowmeter with a probe of the ascending aorta. M.W.R.

N65-32115*# Massachusetts Inst. of Tech., Cambridge. Psychological Labs.
[MULTIDISCIPLINARY RESEARCH IN THE SPACE RELATED PHYSICAL, ENGINEERING, SOCIAL AND LIFE SCIENCES] First Semiannual Progress Report, 1 Jun.–1 Dec. 1963
Jan. 1964 42 p refs
(Grant NsG-496)
(NASA-CR-58831) CFSTI: HC $2.00/MF $0.50 CSCL 05J

An overview of research studies is physiological, experimental, developmental, and comparative psychology is presented. Studies of effects of brain injury in adults and children are reported; and researches with experimental animals deal with ablation, stimulation, electrical recordings, and chemical manipulation of the central nervous system. General experimental studies are concerned with perception, sensorimotor coordination, memory, learning, and thought. Infants and children have been observed in various developmental studies including the effects of early experience, orientation, and acquisition of values. Studies in comparative psychology deal with visual training in goldfish, novelty-seeking in hamsters, perception organization in kittens, and formation of learning sets in tree shrews, stumptail macaques, and rhesus monkeys. M.W.R.

N65-32144# European Atomic Energy Community, Brussels (Belgium).
THE EFFECT OF NICOTINAMIDE ON X-IRRADIATED SUSPENSION CULTURES OF RAT BONE MARROW CELLS
J. F. Whitfield, T. Youdale, and H. Brohee 1965 22 p refs (EUR-2415.e) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 40 Belg. Fr.

During the first 6 hours after irradiation (250 to 1500 r) of suspension cultures of rat bone marrow, the nuclei of the various "blast" cells, promyelocytes, myelocytes, normoblasts and cells of the lymphocyte family, lost their reticular structure and became structurally homogeneous. This change could be retarded by adding nicotinamide (0.075M) to the culture immediately after irradiation. Lactate production was slightly stimulated by irradiation (500 r). Lactate production in both normal and irradiated cultures was reduced by exposure of the cells to nicotinamide. Author

N65-32265*# National Aeronautics and Space Administration, Washington, D. C.
ON THE EARTH-MOON ROUTE—A BIOLOGICAL EVALUATION OF RADIATION IN SPACE FLIGHTS [NA TRASSE ZEMLYA-LUNA—BIOLOGICHESKAYA OTSENKA RADIATSIONNOY OPASNOSTI KOSMICHESKIKH POLETOV]
V. V. Antipov, M. D. Nikitin, and P. P. Saksonov Aug. 1965 15 p Transl. into ENGLISH from Priroda (Moscow), no. 4, 1965 p 46–53
(NASA-TT-F-9458) CFSTI: HC $1.00/MF $0.50 CSCL 06R

The physical characteristics of the main types of cosmic radiation were analyzed, and the biological dosages caused by each type of radiation were determined. It was found that a 1 to 2 g/cm^2 shield would insure safety from radiation for the crew of a two-week flight around the Moon during a quiet solar period. The danger of proton radiation from solar flares can be reduced by predictions of these flares, and by increased resistance of the organism to the action of protons through medicinal preparations. G.G.

N65-32277*# Stanford Research Inst., Menlo Park, Calif.
DEVELOPMENT OF A BLOOD-PRESSURE TRANSDUCER FOR THE TEMPORAL ARTERY
G. L. Pressman and P. M. Newgard Washington, NASA, Sep. 1965 69 p refs
(Contract NAS2-1332)
(NASA-CR-293) CFSTI: HC $3.00/MF $0.75 CSCL 06B

This report describes three phases of research on the direct force method of externally measuring arterial blood pressure. First, a miniaturized transducer was designed specifically for application on the superficial temporal artery of man. This device incorporated a differential-transformer sensing element with special mounting to reduce response to acceleration. Second, a transducer of earlier design, intended for the radial artery of man and using strain-gauge techniques was extensively tested on experimental animals and compared with direct intra-arterial measurements. Finally, a number of techniques for the sensing of the transducer position over the artery were investigated both theoretically and experimentally. Author

N65-32344# Joint Publications Research Service, Washington, D. C.
REACTIONS OF THE CARDIOVASCULAR AND RESPIRATORY SYSTEMS OF COSMONAUTS UNDER THE CONDITIONS OF ORBITAL FLIGHT ON THE SPACESHIP 'VOSKHOD-1'
P. V. Vasil'yev, A. D. Voskresenskiy, I. I. Kas'yan, D. G. Massimov, I. D. Pestov et al 8 Sep. 1965 15 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Biol. (Moscow), no. 4, Jul.–Aug. 1965 p 491–499
(JPRS-31913; TT-65-32407) CFSTI: $1.00

Pulse and respiratory rates were determined for the cosmonauts during the flight of Voshkod I, with the two or three respiratory cycles selected from each recorded minute to reflect the dynamics from one flight orbit to the next. Data presented indicate results comparable to those obtained during previous orbital flights, although some individual peculiarities were recorded. During the sixth orbit, one of the cosmonauts who was asleep displayed a pronounced vagotonic reaction and his pulse rate fell to 45 to 48 beats per minute, during sleep on earth this rate was never less than 52. It was found that respiration rates gradually increased during the first six orbits, during the sixteenth orbit the average respiration rate was only somewhat higher than during countdown, although the range of respiration rates was almost half that during countdown and the first orbit. This may reflect changes in general conditions of the cosmonauts in the process of their adaptation to orbital flights and, in particular, to weightlessness. M.W.R.

N65-32350# California Univ., Davis. . School of Veterinary Medicine.
THE EFFECTS OF CONTINUED Sr-90 INGESTION DURING THE GROWTH PERIOD OF THE BEAGLE AND ITS RELATION TO Ra-226 TOXICITY Annual Progress Report No. 8
A. C. Andersen Jun. 1965 180 p refs
(Contract AT(04-3)-472)
(UCD-472-112) CFSTI: $5.00

Various studies on the continued effects of Sr-90 ingestion during the growth period of the beagle, and its relation to Ra-226 toxicity, are presented. Included are: clinical blood chemistry in beagles, roentgenographic survey, determination of zinc and iron in biologic materials by X-ray fluorescence spectrometry, vitamin stability and retention in prepared dog food as influenced by storage, uptake and retention patterns in uniformly labeled beagles, skeletal dosimetry and the exposure status of the colony, and ion exchange removal of Sr-90 from biologic wastes. R.W.H.

N65-32356# Joint Publications Research Service, Washington, D. C.
THE PROBLEM OF REACTIVITY IN SPACE MEDICINE
V. V. Parin, P. V. Vasil'yev, and V. Ye. Belay 8 Sep. 1965 17 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Biol. (Moscow), no. 4, Jul.–Aug. 1965 p 481–490
(JPRS-31909; TT-65-32403) CFSTI: $1.00

Reactivity, or an organism's response to environmental stimuli, and the use of pharmacological substances to increase resistance to such physical, nervous and emotional stresses, were investigated. In animal experiments, the change

in reactivity prior to centrifuge testing was achieved by administering such pharmaceuticals as strychnine, epinephrine, norepinephrine, phenamine (benzedrine), phenatine, ephedrine, caffeine, corasole, K-strophanthin, nitroglycerin, dibasol, chloral hydrate, and thiopental sodium. These experiments established that resistance can be increased if the dose, period, and administration method are optimally selected. The best results were obtained from using strychnine, certain sympathomimetic drugs, and narcotics. Findings also indicate that accelerations change the organism's reactivity to narcotics, cardiac glucosides, vasoconstrictors, and vasodilators. It is pointed out that environmental conditions of an organism greatly influence the effect of drugs, and that knowledge of drug action under changed reactivity is essential. M.G.J.

N65-32357# Los Alamos Scientific Lab., N. Mex.
SOME BIOLOGICAL ASPECTS OF RADIOACTIVE MICROSPHERES
23 Aug. 1965 69 p refs
(Contract W-7405-ENG-36)
(LA-3365-MS) CFSTI: $3.00

The biological effects of particulate radiation sources produced by atmospheric reentry and destruction of space nuclear power systems are discussed. Emphasis was placed on fissioned $^{235}UC_2$ microspheres of about 100 to a few hundred μ. All pyrocarbon-coated and about 85 percent of uncoated $^{235}UC_2$ particles maintained their integrity for 42 hours in gastric juices. Uncoated particles placed in situ underwent solubilization in 4 to 6 weeks; coated ones were still partially intact after 8 to 12 weeks. Emergent beta ray dosage as a function of depth of skin was found to be about 20 percent lower than calculated values. Beta-ray dosage above 10 000 rads produced small areas of erythema on the skin of backs of monkeys. These lesions persisted for three weeks. G.G.

N65-32373# Joint Publications Research Service, Washington, D. C.
CHANGE OF A DOG'S BLOOD COAGULATION SYSTEM WITH TRANSFUSION OF BK-8 PROTEIN BLOOD SUBSTITUTE
N. A. Gorbunova and V. B. Troitskiy 30 Aug. 1965 6 p refs Transl. into ENGLISH from Patol. Fiziol. i Eksperim, Terapiya (Moscow), v. 9, no. 3, May–Jun. 1965 p 71–73
(JPRS-31763; TT-65-32258) CFSTI: $1.00

It was found that the blood coagulation process was slowed down for 24 to 72 hours after transfusions of protein blood substitute (designated BK-8) and native ox plasma in dogs who had suffered acute blood losses. This was explained by changes in the anticoagulant system of the dog as well as by the entry of a great quantity of free heparin in the blood. Results are given for ten dogs before blood letting and after transfusion; two of the dogs died between two and three hours after transfusion. For the other dogs, it was noted that blood coagulation time increased two to four and a half times after the transfusion. At the same time tolerance to heparin decreased while its quantity increased. Antithrombin activity increased and use of prothrombin sharply decreased. Concentrations of AC-globulin and prothrombin did not change materially. After 72 hours, the coagulation times did not differ from those evident before blood letting and transfusion with the blood protein; with the ox plasma transfusion the recovery of the coagulation system was observed in 24 hours and there was complete recovery in 72 hours. M.W.R.

N65-32377# Joint Publications Research Service, Washington, D. C.
VARIATIONS OF ACCLIMATIZATION AT HIGH ALTITUDE
M. M. Sirotinin 30 Aug. 1965 11 p refs Transl. into ENGLISH from Fiziol. Zh., Akad. Nauk Ukr. RSR (Kiev), v. 11, no. 3, May–Jun. 1965 p 283–288
(JPRS-31761; TT-65-32256)

The effects of such climatic factors as oxygen deficiency, ultraviolet radiation, atmospheric ionization, and decreased environmental temperature are assessed in discussing acclimatization to high altitude climates. Adaptation to hypoxia under various conditions, including pressure chamber tests and mountain climbing expeditions, is also disucssed. A literature survey was made, and findings on blood studies, pulmonary ventilation, oxygen tension in the tissues, and morphological changes are reported; the bibliography is included. M.G.J.

N65-32380# Joint Publications Research Service, Washington, D. C.
THERAPEUTIC APPLICATION OF ELECTRO-SLEEP
Z. S. Kuleshova 2 Sep. 1965 32 p refs Transl. into ENGLISH from "Lechebnoye Primeneniye Elektrosna" Moscow, Min. of Health USSR, 1964 39 p
(JPRS-31837; TT-65-32332) CFSTI: $2.00

Applications of a therapeutic method, called electrosleep, for direct action on the central nervous system by a weak, low frequency impulse current, are reviewed. The current characteristics, electrodes, and mechanism of action of the method are discussed. The method is considered with respect to hypertonic and ulcerous illnesses, neural and psychiatric practice, treatment of traumatic illness of the brain, schizophrenia, neuro-psychic illnesses of children and adolescents, treating eczema and neurodermatitis, bronchial asthma, brain vessel sclerosis, hypotonic illness, illusory pains, and glaucoma. It is indicated that variations in the method of application can be used as a sleep therapy method, and as a special factor in changing the functional state of the central nervous system by means of gradual strengthening and self-developing inhibition processes. Side effects are absent, and the method seems safe. L.S.

05 BIOTECHNOLOGY

Includes life support systems, human engineering, crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N65-31484 Naval Research Lab., Washington, D. C.
CONTAMINANTS IN THE SEALAB I ATMOSPHERE
Raymond A. Saunders *In its* Rept. of NRL Progr. May 1965 p 1–7 refs Presented at Conf. on Atmospheric Coat in Confined Spaces, Dayton, Ohio, 31 Mar.–2 Apr. 1965 (See N65-31483 20-34)

The latest experiment in the "Man-in-the-Sea" Program was conducted recently off the coast of Bermuda by the Navy's Special Projects Office. Four scuba divers remained at a depth of 193 feet for 11 days, spending their off-duty time in a suitably-equipped pressure vessel called SEALAB I, which rested on the seabottom. The atmosphere in SEALAB consisted of 4% oxygen, 16% nitrogen and 80% helium at a total pressure of 110 psi. Trace organic contaminants which developed in this exotic atmosphere were sampled with activated charcoal. Contaminants were recovered from the charcoal in the laboratory, separated with a gas chromatograph, trapped from the chromatographic effluent with a fraction collector, and identified by means of their infrared and mass spectra. Almost one hundred trace contaminants were recovered and identified or characterized. Author

N65-31557# Lockheed Missiles and Space Co., Sunnyvale, Calif.
STUDY OF HUMAN PERFORMANCE IN A MARK IV PRESSURE SUIT
A. K. Miller and R. S. Lincoln 15 Nov. 1964 38 p ref
(LMSC-6-62-64-19)

Two subjects wearing Mark IV pressure suits, under both the pressurized and unpressurized condition, were tested on several performance tasks. The purpose of the study was to provide an evaluation of performance tasks under suit conditions. Results of the study indicated that the tasks can be successfully presented on an oscilloscope under computer control to evaluate performance capability of suited crew members. Two interesting effects identified in the experimental data were related to characteristics of the pressure suit. When pressurized: (1) The subjects were hindered in the performance of a tracking task because they were unable to rotate their wrists, and (2) One subject had difficulty operating push buttons, which were separated by 5/8 in. between edges, because of the characteristics of the gloves included with the Mark IV suit. Author

N65-31622# Westinghouse Electric Corp., Elmira, N. Y. Electronic Tube Div.
SOLID STATE IMAGE INTENSIFIERS, PHASE III. A BROAD CONTINUING PROGRAM FOR THE APPLICATION OF LIGHT AND IMAGE INTENSIFICATION TECHNIQUES TO MILITARY TRAINING Annual Report
D. C. Fowlis, R. D. Harder, R. E. W. Lake, Z. Szepesi, W. A. Thornton et al Port Washington, N. Y., Naval Training Device Center, Mar. 1965 100 p refs
(Contract N61339-1440; Proj. LIT)
(NAVTRADEVCEN-1440-1; AD-619066)

Progress is reported in the development of image intensifier panels with improved characteristics. Panels with the best uniformity, least graininess, and widest half-tone range reproducing capability had maximum standard luminous gains of 20 foot-Lambert per foot-candle and maximum output brightnesses of 30 foot-Lamberts at 200 V and 2000 cps. Response times between 50 and 500 msec were measured. A parameter study of the PC-EL circuit was made with the digital computer; CdSe sintered layers were analyzed and improved; improved image quality of the low resolution image intensifier panel was obtained; and evaporated EL films were prepared with improved reproducibility and longer life. Also, evaporated PC and EL films were built together. E.E.B.

N65-31630# Aerospace Medical Div., Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
ACOUSTICAL EVALUATION OF X-20A DYNA-SOAR FULL-PRESSURE SUIT ASSEMBLIES
Henry C. Sommer and Harald K. Hille May 1965 32 p refs
(AMPL-TR-65-86; AD-618715)

This report presents comparative acoustical data for the "training" model and the "flight-ready" model of the Dyna-Soar X-20A full pressure suit assemblies. For each model the acoustical protection was determined (1) from the subjective measurements of Real-Ear Attenuation at Threshold (REAT) for pure tones and (2) from the objective measurement of transmission loss for wide band noise as recorded outside and inside the helmet at the lip microphone and ear cup positions. Evaluation of the data as measured by the REAT method showed that the training models provide more attenuation than the flight-ready model at the higher frequencies which is the result of a better seal between the ear cup and skull in the training model. The measurement of the transmission loss showed little difference between the two models of the suit assemblies. On the basis of calculated noise levels in the command module of the Dyna-Soar X-20A vehicle, no reduction in speech transmission and reception by the environmental noise is expected for either model. Author

N65-31715# Joint Publications Research Service, Washington, D. C.
HUMAN WORK CAPACITY UNDER CONDITIONS OF WEIGHTLESSNESS
A. V. Yeremin, I. I. Kas'yan, I. A. Kolosov, V. I. Kopanev, and V. I. Lebedev 23 Aug. 1965 10 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Biol. (Moscow), no. 3, May–Jun. 1965 p 329–334
(JPRS-31665; TT-65-32160) CFSTI: $1.00

Human work capacity remains at a fairly high level during space flights lasting up to five days when cosmonauts remain well secured to work stations within the spacecraft. As the length of space flight and complexity of tasks to be performed increase and when spacemen are in unsupported positions, some decrease in work capacity is anticipated. The authors feel that higher criteria for the selection and training of cosmonauts are indicated to overcome the undesirable effects of prolonged weightlessness. M.W.R.

N65-31969# Yale Univ., New Haven, Conn.
STUDIES IN FORCED COMPLIANCE. I: THE EFFECT OF PRESSURE FOR COMPLIANCE ON ATTITUDE CHANGE PRODUCED BY FACE-TO-FACE ROLE PLAYING AND ANONYMOUS ESSAY WRITING
J. Merrill Carlsmith, Barry E. Collins, and Robert L. Helmreich Jul. 1965 36 p refs
(Contract Nonr-4629(00); Grant NSF GS-492)
(TR-1; AD-617418)

One half of the experimental subjects (male high school students) were enticed to tell the next subject (a female accomplice) that the experimental task was interesting, exciting, fun, and enjoyable (when, in fact, it was quite dull). The other half of the experimental subjects wrote an anonymous essay to the same effect. Experimental subjects were paid an additional $0.50, $1.50, or $5.00 for this counter-attitudinal response. Control subjects merely worked on the experimental task and completed the posttest. The data from the face-to-face condition replicates the original Festinger and Carlsmith experiment; small amounts of money were most effective in convincing subjects that the task was really fun and interesting. Data from the essay condition, however, indicated just the opposite. Large amounts of money produce the most attitude change. Author

N65-31974# Army Natick Labs., Mass. Clothing and Organic Materials Div.
TEXTILES FOR THERMAL RADIATION PROTECTION
Earl T. Waldron Apr. 1965 39 p refs
(TS-132; AD-617707)

The degree of thermal radiation protection provided by a fabric is influenced by the weight of the material, the type of dyestuffs and chemical finishes used, the synergistic effects from blending the fibers, and the chemistry of the fibers. The net thermal protection provided by an ensemble is further influenced by the ignition characteristics of the outer layer and the manner in which the layers are put together. Reflective sub-layers add protection when used with a diathermanous outer layer; sub-layers that incorporate volatile finishes are a hazard when used with impermeable or slightly permeable outer layers. Of the fibers immediately available from industry, the blends of cotton with nylon showed the best performance in solar furnace and carbon arc tests and their efficiency was increased with

available finishes. Of the synthetic fibers examined, experimental Fiber 6 was found to provide significantly greater protection than either the present cotton uniforms or the cotton/nylon blends. Author

N65-32033*# Massachusetts Inst. of Tech., Cambridge. Man-Vehicle Control Lab.
THE VESTIBULAR SYSTEM AND HUMAN DYNAMIC SPACE ORIENTATION
Jacob L. Meiry (Ph.D. Thesis) Jun. 1965 205 p refs
(Grant NsG-577)
(NASA-CR-64545; T-65-1) CFSTI: HC $6.00;MF $1.25 CSCL 06H

The motion sensors of the vestibular system are studied to determine their role in human dynamic space orientation and manual vehicle control. The investigation yielded control models for the sensors, descriptions of the subsystems for eye stabilization, and demonstrations of the effects of motion cues on closed loop manual control. Experiments on the abilities of subjects to perceive a variety of linear motions provided data on the dynamic characteristics of the otoliths, the linear motion sensors. Angular acceleration threshold measurements supplemented knowledge of the semicircular canals, the angular motion sensors. Mathematical models are presented to describe the known control characteristics of the vestibular sensors, relating subjective perception of motion to objective motion of a vehicle. Author

N65-32223# Hughes Aircraft Co., Fullerton, Calif.
CREATIVE COMPUTATION Final Technical Documentary Report, Feb. 1964–Feb. 1965
F. B. Cannonito, V. H. Dyson, A. Kino, and G. Cash Griffiss AFB, N. Y., RADC, Jun. 1965 69 p refs
(Contract AF 30(602)-3339)
(FR-65-11-44; RADC-TR-65-123; AD-618395)

The subject of artificial intelligence is viewed from the point of view of recursive function theory and mathematical logic. An analysis of several central problems in this area yields the following potential solutions and techniques: (1) realization of A-computations; (2) combinatorial information retrieval systems; (3) classification of data processing problems in algebra; (4) computation with invertible programs; (5) applications of ordinal computability; and (6) investigation of the Mendelson-Takeuti hierarchy. Author

N65-32289# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EVALUATION OF WORKING CONDITIONS OF CIVILIAN AIRPORT RADAR INSTALLATIONS
A. Ya. Loshak and Ye. F. Mar'yechkin 14 Jul. 1965 16 p refs Transl. into ENGLISH from Gigiena i Sanit. (Moscow), no. 7, 1964 p 39–44
(FTD-TT-65-345/1+4; AD-618635)

The radiation power flux density of radar antennas was measured to evaluate working conditions of personnel serving at civilian airport radar installations. Tabulated data are given showing the magnitude of the UHF field (in $\mu w/cm^2$) occurring in search scanning, and in dispatching and landing radar stations, as a function of antenna distance, installation height, and angle of inclination. The data indicate the presence of a reverse interdependence between the intensity of radar emission at the place of measurement, and the height of the installation. The measurements indicate that the higher from the ground that the radiation is recorded, the greater its intensity will be. It was concluded that it is necessary to develop norms for allowable radiation taking into account the periodicity, intensity, and frequency range of the acting UHF energy; and that the high levels of UHF radiation recorded from the antennas require the establishment of zones of sanitary protection, and methods of computating the dosimetric magnitudes of the radiation. L.S.

N65-32303# Ohio State Univ. Research Foundation, Columbus.
INFORMATION PROCESSING IN THE FROG'S RETINA Technical Report, 1 Sep. 1957–29 Feb. 1964
Leo E. Lipetz Wright-Patterson AFB, Ohio, AMRL, Feb. 1965 80 p refs
(Contract AF 33(657)-7578)
(AMRL-TR-65-24; AD-614249)

The information handling properties of the frog's retina were studied by three techniques. (a) An attempt was made to investigate the mutual interaction of excitatory and inhibitory connections to bipolar cells by studying the average electroretinogram response to stimulation with various patterns of light. It was found that present techniques of electroretinography and photometry did not permit the required stability of measurement. (b) Light and electron microscope studies were made of the cell types and connections of the frog's retina. Illustrative micrographs are included in the report. The new findings were made that the Landolt club of the small bipolar cell is a mitochondria-packed process and that it terminates as a cilium in the aqueous space between the visual cells. The large bipolar cells were found most likely to be carriers of "light adaptation" information, the small bipolars of "edge" information. Author

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N65-31250# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CHEMISTRY OF PEROXIDE COMPOUNDS
21 Apr. 1965 126 p refs Transl. into ENGLISH of the book "Khimiya Soyedineniy Perekisi" Moscow, Adak. Nauk SSSR, Inst. Obsch. i Neorgan. Khim., 1963
(FTD-TT-64-958/1+2; AD-617099)

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2. PHOTOLYSIS OF FROZEN SOLUTIONS OF HYDROGEN PEROXIDE IN WATER V. S. Gurman, V. I. Papisova, G. B. Sergeyer, Ye. I. Yakovenko p 16–21 refs (See N65-31251 20-06)

3. THERMODYNAMICS OF CERTAIN PROCESS OF HYDROGEN PEROXIDE IN AQUEOUS SOLUTIONS AT VARIOUS TEMPERATURES I. Ye. Flis, K. P. Mishchenko, V. A. Kustodina, and K. Yu. Salnis p 22–25 refs (See N65-31252 20-06)

4. CONCERNING THE EXISTENCE OF TERNARY COMPOUNDS IN THE NH_3-H_2O_2-H_2O SYSTEMS K. Ye. Mironov p 26–32 refs (See N65-31253 20-06)

5. PEROXIDE COMPOUNDS OF LITHIUM AND THEIR SYNTHESIS T. A. Dobrynina and S. Z. Makarov p 33–43 refs (See N65-31254 20-06)

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8. PRODUCTION OF PEROXIDES OF ALKALI EARTH METALS: CaO_2, SrO_2, BaO_2 N. K. Grigor'yeva, T. I. Arnold, and S. Z. Makarov p 58–69 refs (See N65-31257 20-06)

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11. REACTIONS OF SODIUM AND POTASSIUM SUPEROXIDES WITH WATER VAPOR AND CARBON DIOXIDE AND SYNTHESIS OF PEROXOCARBONATES A. Kh. Mel'nikov, T. P. Firsova, A. N. Molodkina, T. G. Morozova, and I. V. Aksenova p 88–105 refs (See N65-31260 20-06)

12. STUDY OF THE OZONIZATION PROCESS OF Na OH AT LOW TEMPERATURES AND DETERMINATION OF PHYSICO-CHEMICAL PROPERTIES OF SODIUM OZONIDE p 106–114 refs (See N65-31261 20-06)

13. THE STUDY OF SEPARATE STAGES IN THE SYNTHESIS OF POTASSIUM OZONIDE V. G. Karpenko and A. S. Poteryayko p 115–120 refs (See N65-31262 20-06)

N65-31251 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PHOTOLYSIS OF FROZEN SOLUTIONS OF HYDROGEN PEROXIDE IN WATER

V. S. Gurman, V. I. Papisova, G. B. Sergeyer, and Ye. I. Yakovenko *In its* Chem. of Peroxide Compds. 21 Apr. 1965 p 16–21 refs (See N65-31250 20-06)

An investigation was conducted on samples of 25% and 98% hydrogen peroxide solutions in water. The samples were quickly frozen in liquid nitrogen and illuminated with a high pressure mercury lamp. The electron paramagnetic resonance specra of the frozen hydrogen peroxide samples proved the presence of the HO_2 radical. R.N.A.

N65-31252 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THERMODYNAMICS OF CERTAIN PROCESS OF HYDROGEN PEROXIDE IN AQUEOUS SOLUTIONS AT VARIOUS TEMPERATURES

I. Ye. Flis, K. P. Mishchenko, V. A. Kustodina, and K. Yu. Salnis *In its* Chem. of Peroxide Compds. 21 Apr. 1965 p 22–25 refs (See N65-31250 20-06)

The thermodynamic characteristics of the reactions of formation and disintegration of aqueous hydrogen peroxide solutions are described. R.N.A.

N65-31253 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CONCERNING THE EXISTENCE OF TERNARY COMPOUNDS IN THE NH_3–H_2O_2–H_2O SYSTEMS

K. Ye. Mironov *In its* Chem. of Peroxide Compds. 21 Apr. 1965 p 26–32 refs (See N65-31250 20-06)

The diagram of phasal transformations in the NH_3–H_2O_2–H_2O system is used to demonstrate the reasons for making false conclusions concerning the formation of ternary systems between ammonia, hydrogen peroxide, and water. R.N.A.

N65-31254 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PEROXIDE COMPOUNDS OF LITHIUM AND THEIR SYNTHESIS

T. A. Dobrynina and S. Z. Makarov *In its* Chem. of Peroxide Compds. 21 Apr. 1965 p 33–43 refs (See N65-31250 20-06)

A physical–chemical investigation was conducted on the ternary system $LiOH$–H_2O_2–H_2O. As a result, two methods were developed for the synthesis of lithium peroxide through its derivatives of hydrate and peroxyhydrate types: $Li_2O_2 \cdot H_2O$ and $Li_2O_2 \cdot H_2O_2 \cdot (2-3)\,H_2O$. R.N.A.

N65-31255 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

A METHOD FOR OBTAINING BARIUM PEROXIDE FROM BARIUM HYDROXIDE

L. A. Isarov *In its* Chem. of Peroxide Compds. 21 Apr. 1965 p 44–49 ref (See N65-31250 20-06)

An economic method of producing barium peroxide is described. In this method barium peroxide is obtained by dehydrating the octahydrate of barium hydroxide and oxidizing the obtained solid dehydrated barium hydroxide with dry oxygen or air at 550° C. R.N.A.

N65-31256 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

OXIDATION OF CERTAIN INORGANIC SUBSTANCES WITH PEROXIDE COMPOUNDS

V. A. Lunenok-Burmakina, A. P. Potemskaya, and A. N. Gerasenkova *In its* Chem. of Peroxide Compds. 21 Apr. 1965 p 50–57 refs (See N65-31250 20-06)

Oxidation reactions of a series of inorganic substances with hydrogen peroxide and persulfate were studied with tagged O^{18} atoms. The oxidation of inorganic ions with hydrogen peroxide involves different mechanisms. In the oxidation of $Ca(OH)_2$, $Sr(OH)_2$, $Ba(OH)_2$, and $Mn(OH)_2$ with hydrogen peroxide, the formed CaO_2, SrO_2, and BaO_2 acquire oxygen atoms from hydrogen peroxide; whicle $MnO_2 \cdot H_2O$ acquired oxygen atoms from water. In the oxidation reaction of sulfide, only oxygen atoms from hydrogen peroxide enter into the composition of the formed sulfate. In the oxidation of sulfite, two oxygen atoms from H_2O_2 react. Mechanisms are presented for these reactions. The reaction of H_2O_2 with HSO_5^-, $S_2O_8^-$, or $S_2O_8^{2-}$ proceeds with the oxidation of hydrogen peroxide to molecular oxygen with the disintegration of the O–O bond of monosupersulfuric acid, or persulfate. The radical HSO_5^- probably forms in the alkaline solutions. The oxidation of S^{2-}, Ag^+, and Mn^{2+} with persulfate proceeds in the same manner with the disintegration of the persulfate O–O bond. In this case, electrons are transferred from the oxidizing substance to the persulfate without the displacement of the oxidizer oxygen atoms. R.N.A.

N65-31257 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PRODUCTION OF PEROXIDES OF ALKALI EARTH METALS: CaO_2, SrO_2, BaO_2

N. K. Grigor'yeva, T. I. Arnold, and S. Z. Makarov *In its* Chem. of Peroxide Compds. 21 Apr. 1965 p 58–69 refs (See N65-31250 20-06)

Solubility in hydroxide systems of alkali earth metal–hydrogen peroxide–water was investigated in a wide temperature interval and concentration of hydrogen peroxide. The thermal stability of solid phases in these systems was also studied. As a result, methods were developed for synthesizing calcium, strontium and barium peroxides. R.N.A.

N65-31258 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF PEROXYHYDRATES AND HYDRATES OF RUBIDIUM AND CESIUM CARBONATES
B. S. Dzyatkevich and T. A. Dobrynina *In its* Chem. of Peroxide Compds. 21 Apr. 1965 p 70–74 refs (See N65-31250 20-06)

A study was conducted to determine compositions of peroxyhydrates of rubidium and cesium carbonates, and to establish a pattern in the formation of peroxyhydrates in a series of alkali metal carbonates. The investigation was performed on Rb_2CO_3–H_2O_2–H_2O and Cs_2CO_3–H_2O_2–H_2O systems by using the solubility method at temperatures of 0°, −10°, −21°, and −40° C. The binary systems of Rb_2CO_3–H_2O and Cs_2CO_3–H_2O were studied by a visual-polythermal method at low temperatures, and by an isothermal method above 0° C to establish the composition of rubidium and cesium carbonate hydrates. Reactions of alkali metal carbonates with H_2O_2 showed an increasing tendency for peroxyhydrates formation in carbonate series from Li_2CO_3 to Cs_2CO_3. Investigation of ternary systems Rb_2CO_3–H_2O_2–H_2O and Cs_2CO_3–H_2O_2–H_2O showed the existence of $Rb_2CO_3 \cdot 6H_2O_2$ and $Cs_2CO_3 \cdot 3H_2O_2$ compounds, and confirmed the formation of $Rb_2CO_3 \cdot 3H_2O$. M.R.W.

N65-31259 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATING THE REACTION PROCESS OF CARBON DIOXIDE WITH ALKALINE SOLUTIONS OF HYDROGEN PEROXIDE AND THE SYNTHESIS OF PEROXOCARBONATES
T. P. Firsova, A. N. Molodkina, T. G. Morozova, and I. V. Aksenova *In its* Chem. of Peroxide Compds. 21 Apr. 1965 p 75–87 refs (See N65-31250 20-06)

A method, based on the carbonization of aqueous alkaline solutions of hydrogen peroxide, was developed for synthesizing alkaline metal percarbonates (peroxocarbonates). Studies were also conducted to confirm and explain the low temperature reaction mechanism of sodium and potassium superoxides with water vapor and carbon dioxide. Tests indicate that the reaction can proceed only in the presence of water vapor. Data on the physicochemical properties of percarbonates are also included. M.R.W.

N65-31260 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
REACTIONS OF SODIUM AND POTASSIUM SUPEROXIDES WITH WATER VAPOR AND CARBON DIOXIDE AND SYNTHESIS OF PEROXOCARBONATES
A. Kh. Mel'nikov, T. P. Firsova, A. N. Molodkina, T. G. Morozova, and I. V. Aksenova *In its* Chem. of Peroxide Compds. 21 Apr. 1965 p 88–105 refs (See N65-31250 20-06)

Studies were conducted to investigate the reaction kinetics of sodium and potassium superoxides with water vapor and carbon dioxide at low temperatures, and to examine the peroxide type solid phases formed in the reaction process. Sodium and potassium were found to react with water vapor and carbon dioxide in the temperature range from +10° C to −10° C, liberating superoxide oxygen and forming sodium and potassium peroxodicarbonates. Studies indicate that formation of the peroxodicarbonates proceeds through peroxide hydrates. Thermal stability of peroxide hydrates determines the upper temperature limit for the formation of peroxodicarbonates in the reaction of carbon dioxide and superoxides. Intermediate phases $Na_2O_2 \cdot 8H_2O$, $Na_2C_2O_6$ and $K_2C_2O_6$ were synthesized at low temperatures, in the reaction of sodium and potassium superoxides with water vapor and carbon dioxide. A study of such properties as thermal stability, specific weight, and hydrolysis is included. M.R.W.

N65-31261 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STUDY OF THE OZONIZATION PROCESS OF NaOH AT LOW TEMPERATURES AND DETERMINATION OF PHYSICOCHEMICAL PROPERTIES OF SODIUM OZONIDE
In its Chem. of Peroxide Compds. 21 Apr. 1965 p 106–114 refs (See N65-31250 20-06)

A study was made of the ozonization process of sodium hydroxide in the temperature interval +40° to −100° C to investigate the possibility of synthesizing higher oxide compounds of alkali metals. The extracted sodium ozonide, which contained 80% to 90% NaO_3, was subjected to X-ray analysis and differential thermal studies to investigate physical and chemical properties. Formation rates in respect to time and temperature were established, and diagrams are shown. M.R.W.

N65-31262 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE STUDY OF SEPARATE STAGES IN THE SYNTHESIS OF POTASSIUM OZONIDE
V. G. Karpenko and A. S. Poteryayko *In its* Chem. of Peroxide Compds. 21 Apr. 1965 p 115–120 refs (See N65-31250 20-06)

Experiments to determine the effect of temperature and ozone concentration on the formation rate of potassium ozonide were conducted in the temperature range from −20° to +5° C, with ozone concentration from 5% to 9% (weight). The maximum reaction rate was observed at +5° C, and the maximum content of 28% active oxygen was achieved in the ozonized alkaline solution. A description and diagram of the boiling layer reactor used for the synthesis are also included. M.R.W.

N65-31307# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md. Chemical Propulsion Information Agency.
INTERAGENCY CHEMICAL ROCKET PROPULSION GROUP, WORKING GROUP ON THERMOCHEMISTRY, VOLUME 1
Jul. 1965 160 p refs Proc. of 3d Meeting held at Aerospace Corp., El Segundo, Calif., 17–18 Mar. 1965
(Contract NOw-62-0604-c)
(CPIA-Publ.-82; AD-467028)

Studies of thermodynamic and spectrum properties of halides and light and heavy elements are presented. For individual titles see N65-31308–N65-31327.

N65-31308 National Bureau of Standards, Washington, D. C.
A SURVEY OF THE THERMODYNAMIC DATA ON HEAVIER ELEMENTS AND THEIR COMPOUNDS. HIGH-TEMPERATURE ENTHALPY AND VAPORIZATION EQUILIBRIA
Thomas B. Douglas In APL ICRPG Working Group on the Thermochem., Vol. I Jul. 1965 p 5–16 refs (See N65-31307 20-06)
(ARPA Order 20)

A comprehensive, though not all-inclusive, survey of the published literature was undertaken for the purpose of determining where high-temperature enthalpy and vaporization-equilibrium data appear to be lacking or inadequate for Ti, Zr, W, Pb, Hg, I, Hf, Th, U, and their light-element compounds considered to be of possible importance in chemical propulsion and refractory applications. The results of this survey are summarized, and several examples are presented of the effects of uncertainties in the standard thermodynamic properties on calculated equilibria at high temperatures. It is pointed out that the first ionization potential of a molecule containing one alkali atom can be expected to exceed that of the free alkali atom by approximately the dissociation energy of the neutral molecule; and this relation is verified, within experimental uncertainty, for several examples. Author

N65-31309 Aerospace Corp., El Segundo, Calif. Labs. Div.
CALCULATION OF EQUILIBRIUM ELECTRON AND ION CONCENTRATIONS
Eileen A. Cook *In* APL ICRPG Working Group on the Thermochem., Vol. I Jul. 1965 p 17–20 refs (See N65-31307 20-06)
(Contract AF 04(695)-469)

The thermodynamic data requirements for equilibrium propellant performance calculations are discussed. The inclusion of ionic species to obtain electron densities and ionized product concentrations for solid propellants and re-entry ablative materials is considered. Author

N65-31310 Aerospace Corp., El Segundo, Calif. Technical Operations.
THE IMPLICATIONS OF JANAF DATA IN NEW COMPUTER PROGRAMMING
H. J. Vale *In* APL ICRPG Working Group on the Thermochem., Vol. I Jul. 1965 p 21–24 (See N65-31307 20-06)

New computer programming in the area of chemical thermodynamics has shown a need for amplifying JANAF data coverage. The needed data should include ionic species and temperature extension to about 30,000° K. In addition, recent studies of the use of thermodynamic data in conjunction with kinetic rate equations shows that more considerations should be given to the mutual consistency of these equations and the data over a wide temperature range. Author

N65-31311 National Bureau of Standards, Washington, D. C.
HEAT OF CHLORINATION OF ALUMINUM BOROHYDRIDE
A. A. Gilliland and D. D. Wagman *In* APL ICRPG Working Group on the Thermochem., Vol. I Jul. 1965 p 25–29 (See N65-31307 20-06)

Experiments were performed on aluminum borohydride to determine its heat of chlorination. Initial attempts to obtain a suitable calorimetric reaction involved bomb reactions with N_2 under pressure, Cl_2(g), and water vapor. In all cases a mixture of unidentified reaction products were obtained, including strong odors indicating the probable presence of boron hydrides. Attempts to bubble $Al(BH_4)_3$ vapor into dilute hydrochloric acid solutions also failed to produce well defined products. A vapor phase chlorination reaction was finally selected using a flow calorimeter designed to maintain a steady flame at the burner tip. The procedure is similar to that used for the oxygen flame combustion of hydrocarbons and is described. No spark ignition is required as the chlorination reaction proceeds spontaneously. The results of electrical energy calibration and chlorination calorimetric experiments are tabulated. R.N.A.

N65-31312 Rice Univ., Houston, Tex. Dept. of Chemistry.
MOLECULAR PARAMETERS AND THERMODYNAMIC PROPERTIES OF LIGHT ELEMENT MOLECULES
John L. Margrave et al. *In* APL ICRPG Working Group on the Thermochem., Vol. I Jul. 1965 p 33–43 refs (See N65-31307 20-06)

The high temperature behaviors of a variety of fluorides and other light element compounds has been studied by calorimetric, optical and mass spectrometric and other techniques. Heats of formation, dissociation energies, molecular structures and other parameters have been evaluated. In addition, a program of synthetic inorganic chemistry has led to the preparation and characterization of several new silicon-fluorine compounds. Author

N65-31313 Maremont Corp., Pasadena, Calif. Research Div.
STUDIES OF THE THERMODYNAMIC PROPERTIES OF COMPOUNDS OF THE LIGHT METALS
Michael A. Greenbaum and Milton Farber *In* APL ICRPG Working Group on the Thermochem., Vol. I Jul. 1965 p 45–53 refs (See N65-31307 20-06)

High temperature physical and thermodynamic data on compounds of the light metals, notably beryllium, aluminum, boron and magnesium have been obtained using equilibrium thermodynamic techniques. Several new experimental techniques have been developed and two new mathematical treatments of experimental data have been derived. This paper contains a brief summary of this work which has been carried out over the past four years. Author

N65-31314 IIT Research Inst., Chicago, Ill.
INFRARED SPECTRA BY MATRIX ISOLATION OF SOME LOW MOLECULAR WEIGHT INORGANIC HALIDES
Alan Snelson *In* APL ICRPG Working Group on the Thermochem., Vol. I Jul. 1965 p 55–69 refs (See N65-31307 20-06)
(Contract DA-31-124-ARO(D)-111; ARPA Order 458)

The infrared spectra of the vapors above MgF_2, CaF_2, SrF_2, BaF_2, LiF and $LiAlF_4$ at elevated temperature have been recorded using the matrix isolation technique. Frequency assignments have been made for some of these compounds and their reliability assessed by comparison between the calculated and experimental entropy. Author

N65-31315 General Electric Co., Philadelphia, Pa. Space Sciences Lab.
FURTHER INFRARED STUDIES ON THORIA, ZIRCONIA, AND LITHIUM FLUORIDE BY MATRIX ISOLATION
Milton J. Linevsky *In* APL ICRPG Working Group on the Thermochem., Vol. I Jul. 1965 p 71–77 refs (See N65-31307 20-06)

Further studies of the infrared spectra of the important vapor species over thoria, zirconia and lithium fluoride have been made using the techniques of matrix isolation. Isotopically enriched materials and double-oven techniques were used. ThO_2 and ZrO_2 were found to be highly bent with an apex angle around 106° and 110° respectively. The previously unreported B_{1u} mode of Li_2F_2 has been found. Author

N65-31316 National Bureau of Standards, Washington, D. C.
HIGH TEMPERATURE MATRIX SPECTROSCOPY: GROUP II A FLUORIDES
D. E. Mann *In* APL ICRPG Working Group on the Thermochem., Vol. I Jul. 1965 p 79–80 refs (See N65-31307 20-06)

Some preliminary results are presented of an examination of the infrared spectra of magnesium fluoride, calcium fluoride, strontium fluoride, and barium fluoride isolated in krypton matrices as part of an investigation of the Group II halides. R.N.A.

N65-31317 National Bureau of Standards, Washington, D. C. Heat Div.
COMBUSTION AND REACTION CALORIMETRY OF SEVERAL COMPOUNDS OF INTEREST IN A LIGHT ELEMENT PROGRAM
George T. Armstrong *In* APL ICRPG Working Group on the Thermochem., Vol. I Jul. 1965 p 81–88 refs (See N65-31307 20-06)

The heat of formation of beryllium fluoride has been determined by direct combination of the elements. Using two samples of different purities and particle sizes, concordant results were obtained, despite marked differences in the completeness of reaction. The heat of formation is −242.89 kcal mol^{-1}, with a standard error of 0.29 kcal mol^{-1} computed from seven determinations (preliminary figures). A study of the heat of solution of beryllium metal powder in HF(aq) in a rotating bomb calorimeter has been initiated, and the experimental procedures have been worked out for obtaining valid heat measurements. Author

N65-31318 Aeronutronic, Newport Beach, Calif.
RECENT THERMOCHEMICAL STUDIES
D. L. Hildenbrand *In* APL ICRPG Working Group on the Thermochem., Vol. I Jun. 1965 p 89–92 refs (See N65-31307 20-06)
(Contracts AF 49(638)-1397; AF 04(611)-8523)

New data on the dissociation energies of BeF and BF are given, and some further information about the molecular constants of the Group IIA dihalides is presented. Author

N65-31319 Little (Arthur D.) Inc., Cambridge, Mass.
RECENT MASS SPECTROMETRIC STUDIES
Alfred Büchler *In* APL ICRPG Working Group on the Thermochem., Vol. I Jul. 1965 p 93–100 refs (See N65-31307 20-06)

Mass spectrometric studies are summarized in three areas: oxides, nitrates, and nitrites; mixed halide systems; and rhenium trichloride and rhenium tribromide. (1) The heats of formation of beryllium and lithium metaborate were compared with those of the corresponding fluorides and chlorides. It was shown that beryllium fluoride single bond was stonger than the lithium fluoride bond as to the chlorides and metaborates that contained two bonds of equal strength. A series of experiments were conducted to identify the gaseous metal-containing species in the vapor of alkali nitrates and nitrites. (2) The systems that were discussed included LiF-BeF_2, LiF-ZrF_4, LiF-AlF_3, and NaF-AlF_3. These systems were studied by the twin-crucible technique which was used to compare in a single experiment the mass spectrum of a mixture with one of its components. (3) Rhenium trichloride was shown to be trimeric in crystalline form and, on the basis of characteristic spectra, also in solution. The condensed-phase trimer was shown to contain a ring.

R.W.H.

N65-31320 Dow Chemical Co., Midland, Mich. Thermal Research Lab.
THERMODYNAMIC PROPERTIES AND ALLOTROPY OF BERYLLIUM CHLORIDE BETWEEN 13° AND 715°K
R. A. McDonald and F. L. Oetting *In* APL ICRPG Working Group on the Thermochem., Vol. I Jul. 1965 p 101–104 refs (See N65-31307 20-06)
(Contract AF 04(611)-7554)

The thermodynamic properties of beryllium chloride were investigated using three samples. Two forms (α and β) were identified but as many as four forms of solid beryllium chloride were reported. An apparatus was used to study the phase behavior at elevated temperatures. It consisted of a sealed quartz sample tube in an aluminum block furnace with viewing slot and platinum resistance thermometer in an unsilvered Dewar flask. Three values for the heat of formation of beryllium chloride were shown. R.W.H.

N65-31321 Little (Arthur D.) Inc., Cambridge, Mass.
RESEARCH ON THERMODYNAMICS OF THE Al-B-O, Be-B-O AND Al-Be-O SYSTEMS
Paul E. Blackburn *In* APL ICRPG Working Group on the Thermochem., Vol. I Jul. 1965 p 105–114 refs (See N65-31307 20-06)

The thermal properties of the condensed phase and the vapor state of mixed systems are under study. A combination of vacuum balance and mass spectrometry was used to measure properties of the condensate and the vapor. The differential analysis was employed to find the state of the condensed system. The vacuum balance was used with the Knudsen effusion to obtain B_2O_3 activity as a function of composition. This was accomplished by continuously weighing a cell containing Be–B–O, the vapor of which was almost B_2O_3. A similar study was undertaken on the aluminum–boron–oxygen system. Another study showed that the evaporating coefficient of Al_2O_3 lies between 0.5 and 1.0 for liquid and solid Al_2O_3. An evaporation coefficient of one third for solid alumina and of unity for liquid Al_2O_3 was also shown. R.W.H.

N65-31322 Union Carbide Research Inst., Tarrytown, N. Y.
ON C_3 AND TRANSITION-METAL OXIDE MOLECULES
William Weltner, Jr. *In* APL ICRPG Working Group on the Thermochem., Vol. I Jul. 1965 p 115–118 refs (See N65-31307 20-06)

An unsuccessful attempt to observe another electronic transition of C_3 ($^1\Sigma_u^+ \leftarrow X^1\Sigma_g^+$) in a neon matrix at 4° K is described; the spectrum was measured out to the edge of the vacuum-ultraviolet region at 1900 Å. By reasoning from the ground states of TiO and TaO, molecular orbitals may be constructed which allow a prediction of the ground states of the transition-metal diatomic oxides of Groups IIIB to VIB of the Periodic Table. A predicted $^1\Sigma^+$ ground state has been confirmed for ZrO by matrix-isolation work. WO, WO_2, and the larger tungsten oxide molecules are briefly discussed. Author

N65-31323 Astrosystems International, Inc., Fairfield, N. J.
SPECIES IN FLAMES; NEEDS FOR THERMODYNAMIC DATA ON HEAVIER ELEMENTS AND COMPOUNDS
J. Gordon, C. G. Sage, and M. Hauptman *In* APL ICRPG Working Group on the Thermochem., Vol. I Jul. 1965 p 119–135 (See N65-31307 20-06)
(Contracts AF 49(638)-1400; AF 08(635)-3632)

Data are shown for the emission spectra of flames from propellant combustion for a variety of systems. The systems of interest are: H-C-O-F; H-C-O-S; and H-C-O-P. Under conditions where a hydrocarbon fuel was burned with an oxidant containing fluorine and oxygen, a strong IR emission at 7.6μ, which apparently was a CF stretching vibration, was obtained. Oxygen–H_2S or oxygen–hydrocarbon–H_2S can be burned in a torch or rocket engine; in either case strong SO_2V_3 emission occurs at 7.2μ. Numerous pyrotechnic compositions exist incorporating barium as a green light emitter, either BaCl or BaOH. Also of interest are mixed halides and oxyhalides of titanium and zirconium. R.W.H.

N65-31325 United Aircraft Corp., East Hartford, Conn. Research Labs.
FLUORINE COMBUSTION OF ALUMINUM BOROHYDRIDE
Stephen S. Wise *In* APL ICRPG Working Group on the Thermochem., Vol. I Jul. 1965 p 141–148 refs (See N65-31307 20-06)

Measurements have been made of the heat of combustion of aluminum borohydride in fluorine. The value for the heat of combustion is derived as -1919.5 ± 16 kcal/mole. The heat of formation of $Al(BH_4)_3$ (liq.) (25° C) is derived as -26.4 ± 16 kcal/mole. The high uncertainty is due both to the scatter of the results and to uncertainty in the standard state corrections of HF, a product of combustion. Author

N65-31326 National Bureau of Standards, Washington, D. C.
STATUS OF THERMOCHEMICAL DATA ON SOME HEAVY-METAL OXIDES AND HALIDES
Donald D. Wagman *In* APL ICRPG Working Group on the Thermochem., Vol. I Jul. 1965 p 149–160 refs (See N65-31307 20-06)

A review was conducted of the available published data on the chemical thermodynamic properties (heat and free energy of formation, and entropy) of the oxides and halides of mercury, lead, thorium, uranium, tungsten, and tantalum. A summary of the available significant data on the compounds of each element is presented. R.W.H.

N65-31364 California Univ., San Diego.
THE ABUNDANCE OF THE ELEMENTS
Harold C. Urey 24 Oct. 1962 *In* Space Technol. Labs., Inc. Selections from the TRW Space Technol. Labs. Lecture Ser., Vol. 2 1965 p 35–46 refs (See N65-31360 20-34)

Recent determinations of the abundances of the elements are reported, and their formation and derivation are discussed. A tabulation is presented for the abundance of the rare elements, and abundance curves are graphically illustrated for molybdenum isotopes and carbonaceous chondrites. The analysis of elements in various meteorites is summarized, and the densities of the terrestrial planets and moon are tabulated.
M.R.W.

N65-31404# European Atomic Energy Community, Brussels (Belgium).
ON ELECTRON MICROPROBE ANALYSIS—QUANTITATIVE AND STRUCTURAL ANALYSIS OF NUCLEAR MATERIALS
Jun. 1964 211 p refs Proc. of Symp. held at Ispra Joint Nucl. Res. Center, Italy, 7–9 Oct. 1963 In ENGLISH and FRENCH
(EUR-1819-e) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 250 Belg. Fr.

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10. THE APPLICATION OF X-RAY MICROSCOPY TO THE QUALITY CONTROL AND INSPECTION OF COATED PARTICLE FUELS FOR THE DRAGON REACTOR EXPERIMENT J. F. G. Conde p 105–144 refs (See N65-31413 20-22)

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13. A NEW RAPID SCANNING ELECTRON MICROPROBE ATTACHMENT FOR THE CAMECA MICROPROBE C. Conty (Compagnie d'Applications Mecaniques a l'Electronique au Cinema et a l'Atomistique) p 187–195 (See N65-31416 20-14)

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16. PREPARATION OF SPECIMEN FOR ELECTRON MICROPROBE ANALYSIS BY CUTTING WITH A MICROTOME H. Kirchberg (Jung (R.) A. G.) p 223–225 (See N65-31419 20-17)

N65-31405 Atomic Weapons Research Establishment, Aldermaston (England).
SCANNING MICROANALYSIS OF LOW ATOMIC NUMBER ELEMENTS IN METALS
G. V. T. Ranzetta and V. D. Scott *In* EURATOM On Electron Microprobe Analysis—Quant. and Structural Analysis of Nucl. Mater. Jun. 1964 p 1–14 refs (See N65-31404 20-06) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 250 Belg. Fr.

To overcome the problems associated with electron-probe microanalysis of low atomic number elements, apparatus for applying the network method to light element analysis was built. A schematic diagram of the equipment is included. Evaluation tests were performed to determine the effectiveness of the apparatus in detecting and analyzing light elements in the presence of metals widely separated in the periodic table, and experiments were conducted on beryllium, iron–carbon, and uranium specimens; on the detection of nitrogen and its separation from oxygen and carbon; and on the contamination of the specimen surface by carbonaceous material during electron irradiation. Preliminary results show that this method is successful in detecting elements of atomic numbers down to beryllium, and also in separating X-radiation from elements adjacent in the periodic table.
M.G.J.

N65-31406 Atomic Weapons Research Establishment, Aldermaston (England).
QUANTITATIVE MICROANALYSIS OF LOW ATOMIC NUMBER ELEMENTS
G. V. T. Ranzetta and V. D. Scott *In* EURATOM On Electron Microprobe Analysis—Quant. and Structural Analysis of Nucl. Mater. Jun. 1964 p 15–23 refs (See N65-31404 20-06) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 250 Belg. Fr.

Quantitative analyses of the carbon content in silicon carbide, iron carbide, and uranium carbide specimens showed a strong dependence on the probe voltage, with the measured carbon values increasing with a decrease in voltage. Low kilovoltages in the 3 kV to 5 kV range were found preferable, due to lower X-ray absorption resulting from decreased probe penetration, and less background to be subtracted by the network. A comparison is made with previously proposed correction procedures and formulas, and application of a computer program

is discussed. It was found that the sensitivity of the analysis depends upon the number of elements present and their atomic weight. From the results it may be estimated that ~1 wt % of carbon in iron, and 2 wt % carbon in uranium is readily detectable; uranium monocarbide (4.8 wt % carbon), uranium sesquicarbide (7 wt %), and uranium dicarbide (9.1 wt %) should therefore be capable of separation by the network method. M.G.J.

N65-31407 European Atomic Energy Community, Brussels (Belgium).
CALCULATION OF THE DETECTION THRESHOLD AND THE DETECTION LIMIT IN ELECTRON MICROPROBE ANALYSIS
K. Taeffner and R. Theisen *In its* On Electron Microprobe Analysis—Quant. and Structural Analysis of Nucl. Mater. Jun. 1964 p 27–36 refs (See N65-31404 20-06) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 250 Belg. Fr.

To optimize operating conditions when determining trace concentrations in electron microprobe analysis, theoretical calculations were made for the detection limit and the detection threshold by means of probability theory. Formulas show that by increasing the measuring time and the number of measurements, the detection threshold and limit are decreased. A discussion is presented on the application of this increased sensitivity method of analysis, such as determination of solubility limits in multicomponent systems, and investigation of segregation and corrosion problems. M.R.W.

N65-31408 Laboratoires du Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).
MULTIPHASE DIFFUSION STUDIES IN THE U-V-Al AND U-V-Si-Al SYSTEM
F. Casteels, J. J. Huet, and R. Theisen (EURATOM) *In* EURATOM On Electron Microprobe Analysis—Quant. and Structural Analysis of Nucl. Mater. Jun. 1964 p 37–48 refs (See N65-31404 20-06) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 250 Belg. Fr.

Migration kinetics of uranium through a diffusion barrier towards the outer aluminum canning for the design of an aluninum-bonded-natural-uranium fuel for the Orgel Organic Moderated Reactor was investigated. Several types of barriers were studied with the aim of evaluating a conveniently applicable barrier which would (1) permit in-pile operation for at least one year at 450° C; (2) prevent uranium penetration to the outer surface of the can; (3) provide sound metallic bonding between the fuel and the can; (4) prevent very brittle intermetallic diffusion layers; and (5) give low neutron absorption. After initial diffusion studies with possible diffusion barriers such as Cu, Fe, Ni, Cr, Nb, vanadium and recently multiple barriers composed of vanadium on the uranium side, silicon on the uranium side was selected. R.W.H.

N65-31409 Atomic Weapons Research Establishment, Aldermaston (England).
MICROANALYSIS STUDIES OF BERYLLIUM
V. D. Scott and G. V. T. Ranzetta *In* EURATOM On Electron Microprobe Analysis—Quant. and Structural Analysis of Nucl. Mater. Jun. 1964 p 49–58 refs (See N65-31404 20-06) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 250 Belg. Fr.

Results are presented which show the application of combined techniques of electron-probe microanalysis, electron microscopy, and diffraction to problems occurring in beryllium metallurgy. In a corrosion study, electron microscopy in conjunction with diffraction indicated that the surface layers on corroded unalloyed and alloyed beryllium were similar, consisting of beryllium oxide, whereas microanalysis demonstrated that in fact there was a significant difference between the specimens (subsurface regions of the alloy being enriched with calcium addition element). In another study, microanalysis showed a general segregation of iron to the grain boundaries of annealed beryllium which could not be correlated with optically visible precipitates. However fine grain-boundary precipitates were revealed by the electron-microscope, and further heat-treatment experiments showed that the iron segregation corresponded to the removal of the precipitates, confirming that they contained iron. L.S.

N65-31410 Technische Hochschule Carolo Wilhelmina, Brunswick (West Germany).
ABOUT THE PRESENCE OR ABSENCE OF NICKEL AND COBALT IN ABLATION PRODUCTS OF IRON METEORITES
K. Utech and H. Fechtig (Max-Planck-Inst. für Kernphys.) *In* EURATOM On Electron Microprobe Analysis—Quant. and Structural Analysis of Nucl. Mater. Jun. 1964 p 59–61 (See N65-31404 20-06) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 250 Belg. Fr.

The mechanics of cosmic spherule (ablation products from iron meteorites) origin was studied for determining why spherules do not always have the same composition as the parent meteoritic substance. Fusion crusts identical with sediment samples containing no nickel were produced on a piece of meteoritic iron and on an artificial nickel iron alloy of known composition. A small piece of meteoritic nickel iron was entered into an electromagnetic field which held the piece in suspension, and kept it from contact with any other substance. In this position it was made molten, treated with an oxygen shower, and then rapidly cooled in water. The experiment was repeated with the artificial alloy. In both cases a thin fusion crust formed. Microanalyses showed that nickel and cobalt had diffused from the crust into a thin layer below where they became enriched when compared with the composition of the rest of the substance. An intepretation of the results suggests that the smaller a meteorite is that survives ablation through the atmosphere, the greater its nickel content. L.S.

N65-31411 European Atomic Energy Community, Brussels (Belgium).
APPLICATIONS OF X-RAY MICROANALYSIS AND X-RAY PROJECTION MICRORADIOGRAPHY TO THE STUDY OF UNIRRADIATED AND IRRADIATED HIGH TEMPERATURE REACTOR FUELS
R. Theisen *In its* On Electron Microprobe Analysis—Quant. and Structural Analysis of Nucl. Mater. Jun. 1964 p 63–89 refs (See N65-31404 20-06) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 250 Belg. Fr.

X-ray microanalysis was used to study the migration processes of a fueled kernel consisting of vacuum sintered or melted UC_2, $(U\text{-}Th)C_2$, or $(U\text{-}Zr)C$ with pyrolytic carbon or combined ceramic coatings. The solid fission products in and through the pyrolytic coatings were also observed. Uranium penetration proceeded along crystallite boundaries and coating defects in annealed unirradiated and irradiated coated particle fuels at temperatures below 1700° C. Short time high temperature annealing at 2000 to 2400° C, either during the fabrication process or in a separate furnace following the fabrication step produced an effective diffusion barrier. It was found, that a first low density carbon layer, or the deposition of a multilayer coating improves the formation of a finely dispersed reaction zone. An intermediate zirconium carbide layer, following a 25μ first coating of the fuel particle seems to provide an even better dispersion zone. G.G.

N65-31412 Metallwerk Plansee, A. G., Reutte (Austria).
THE INSTABILITY AND DIFFUSION PHENOMENA OF THERMAL TREATED PYROLYTIC CARBON COATED (U, Zr) C PARTICLES
F. Benesovsky, P. Stecher, and R. Theisen (EURATOM) *In* EURATOM On Electron Microprobe Analysis—Quant. and Structural Analysis of Nucl. Mater. Jun. 1964 p 91–104 refs (See N65-31404 20-06) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.180: 250 Belg. Fr.

Electron beam analysis was used to observe the diffusion of pyrolytic coated uranium and zirconium kernels in carbon during vacuum heat treatment at temperatures above 1800° C for up to 200 hrs. Kernels of ZrC-UC solid solution containing 10 Mol percent UC and more, showed a decrease of uranium content in the center of the kernel with a corresponding increase of zirconium content. Uranium had migrated into the pyrographic layer. Kernels containing 65 Mol percent UC were no longer carbon-stable at 2400° C and indicate a two-phase structure. It was concluded, that without homogenizing heat treatment at a given U/Zr ratio, strong local deviations may occur, and that uranium-rich solutions may be present which are no longer carbon-stable. The great difference in thorium cell size does not favor formation of solid solutions of ThC with carbides. G.G.

N65-31414 Commissariat a l'Energie Atomique, Saclay (France).
DETERMINATION OF THE SOLUBILITY OF PLUTONIUM IN α URANIUM BY CASTAING MICROPROBE ANALYSIS [DETERMINATION DE LA SOLUBILITE DU PLUTONIUM DANS L'URANIUM α PAR ANALYSE PONCTUELLE A LA MICROSONDE DE CASTAING]
Michel Dupuy, Guy Moreau, and Daniel Calais *In* EURATOM On Electron Microprobe Analysis—Quant. and Structural Analysis of Nucl. Mater. Jun. 1964 p 145–170 refs In FRENCH (See N65-31404 20-06) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 250 Belg. Fr.

The solubility of plutonium in uranium by a method of solid state diffusion of the couple formed by a uranium–plutonium alloy, and pure uranium is described. The Ellinger, Robillard, and thermic methods of metallographic examination were used. Results of the determination, in addition to uranium spectral emission and solubility figures, are presented in tabular form. A brief bibliography is included.
Transl. by G.A.L.

N65-31415 Atomic Weapons Research Establishment, Aldermaston (England).
MICROANALYSIS OF PLUTONIUM–URANIUM CERAMIC MATERIALS
G. V. Ranzetta and V. D. Scott *In* EURATOM On Electron Microprobe Analysis—Quant. and Structural Analysis of Nucl. Mater. Jun. 1964 p 171–185 (See N65-31404 20-06) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 250 Belg. Fr.

Results are presented which demonstrate that useful information concerning the microstructure of ceramic materials can be readily obtained by electron probe microanalysis. Illustrations are given concerning segregation in mixed uranium and plutonium oxide and carbide ceramics as well as the effect of added elements on the metallographic structure. Microanalysis was concluded to save time and effort in metallographic studies of ceramic specimens and a recommendation was made for its application to the study of phase equilibria. R.N.A.

N65-31444# Hanford Atomic Products Operation, Richland, Wash.
SUPPLEMENTAL STUDIES ON THE SEPARATION OF CERIUM (IV) FROM THE TRIVALENT RARE EARTHS
L. A. Bray and F. P. Roberts 1 Oct. 1964 8 p refs
(Contract AT(45-1)-1350)
(HW-84101)

Results are presented of studies to alleviate the problems experienced in separating cerium from the trivalent rare earths. It was found that with repeated use of the solvent the partition step becomes marginal, and that a loss of trivalent rare earths occurred during the sulfate–silver removal step. Experiments were performed to determine the effect of radiolysis of the solvent on cerium extractions, and to determine if lower concentrations of potassium persulfate and/or silver nitrate could be used if the cerium was allowed to oxidize before contacting the organic phase. The undesired precipitation of rare earth double sulfates under conditions obtained in plant operation was also studied. Among the conclusions are that the separation of cerium is improved by the substitution of a purified straight chain hydrocarbon diluent with 10 to 14 carbon atoms in the chain; that lower concentrations of either silver or persulfate result in marginal distribution ratios; and that addition of N-hydroxyethylethylenediaminetriacetic acid to rare earth solutions prevents precipitation of rare earth double sulfates at pH values greater than about 2.8. C.T.C.

N65-31445# Hanford Atomic Products Operation, Richland, Wash.
THE CSREX PROCESS FOR CO-EXTRACTION OF CESIUM, STRONTIUM, AND RARE EARTHS: PILOT PLANT STUDIES
G. L. Richardson 2 Mar. 1964 30 p refs
(Contract AT(45-1)-1350)
(HW-81091)

The Csrex process, an extraction process for nuclear reactor wastes, was used successfully in pilot plant studies for co-extraction of cesium, strontium, and rare earth metals. The Csrex solvent is a mixture of 4-sec-butyl-2(α-methylbenzyl) phenol (BAMBP) and di-2-ethylhexyl phosphoric acid (D2EHPA) in an inert hydrocarbon diluent. The BAMBP alone is a highly specific solvent for cesium at pH values above 12; when added to the D2EHPA, the combined solvent exhibits maximum cesium extraction between pH values 4 and 5, which is also the optimum pH range for extracting strontium and rare earths. The process was used in pulse columns containing nozzle plate cartridges with either 10 or 23% free area stainless steel. Demonstrated volume velocities exceeded 800 gph/ft^2. The major shortcoming of the Csrex process is the unusually high susceptibility of the solvent to radiation and nitrous acid degradation. J.M.D.

N65-31446# General Dynamics Corp., San Diego, Calif. General Atomic Div.
ADVANCED, GRAPHITE-MATRIX, DISPERSION-TYPE FUEL SYSTEMS Quarterly Progress Report, Period Ending 31 Dec. 1963
J. C. Bokros, W. V. Goeddel, J. R. Hooker, H. K. Lonsdale, J. L. White et al 15 Jan. 1964 19 p refs
(Contract AT(04-3)-167)
(GA-4930, Pt. 1)

Ways of employing modern methods of materials development to obtain substantial improvements in the graphite-matrix fuel systems to be used in high-temperature reactors of advanced design are investigated. Included are studies of the thermal stability and fission-product retention of coated fuel particles and graphite-matrix fuel bodies to evaluate the factors determining the lifetime and limiting temperatures of current

and new graphite-matrix fuel systems. The following studies were also conducted: pyrolytic carbon coating, application of hot-working techniques to fuel compacts, chemical binders for graphite, and diffusion of uranium and thorium in pyrolytic carbon. R.W.H.

N65-31447# Iowa State Univ. of Science and Technology, Ames. Ames Lab.
EQUATION OF STATE OF SIMPLE SOLIDS
C. A. Swenson [1965] 9 p refs Presented at the Intern. Conf. on Phys. of Solids at High Pressures, Tucson, Ariz., 19–21 Apr. 1965
(Contract W-7405-ENG-42)
(IS-1154; Conf-650423-1)

Equation of state data (pressure–volume–temperature) for the alkali metals and the solidified inert gases provide guidance for the extrapolation to higher temperatures and pressures of data for less compressible solids. The piston-displacement technique was used at pressures of 20 kbars to obtain equation of state data from 20° K to the melting point for these elementary solids. Certain regularities were found for the pressure–volume relationships in lithium, sodium, and potassium, and the behavior of the inert gas solids was understood in terms of current theories. The temperature-dependent portion of the equation of state obeys a Mie–Grueneisen relationship with a bulk modulus which is independent of temperature at constant volume. This behavior was understood qualitatively in terms of a simple calculation based on the quasi-harmonic theory of lattice vibrations. R.W.H.

N65-31476# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
RECOVERY OF PLUTONIUM AND URANIUM FROM REACTOR FUEL METALLURGICAL SCRAP
W. W. Schulz Jun. 1965 32 p refs
(Contract AT(45-1)-1830)
(BNWL-57)

Studies focusing on the development, testing, or modification, of solvent extraction flowsheets for separating plutonium from uranium and thorium, are reported. Two flowsheets for the solvent extraction separation of plutonium from uranium and thorium are presented and discussed. In both, uranium and thorium are coextracted (partition column) into a TBP-CCl_4 solvent scrap. The reflux flowsheet was tested extensively in mixer-settler runs as well as on a batch scale. Satisfactorily low losses of thorium and uranium to the aqueous phase in the partition column were achieved at the expense of extraction of 0.1 to 0.2% of the plutonium. The nonreflux flowsheet appeared capable of giving a cleaner separation of plutonium from uranium and thorium, however involved handling large volumes of solution. The possibility of using a static bed of 30% DBBP-CCl_4 to separate plutonium (III) and thorium (after prior extraction of uranium into a TBP-CCl_4 solution) was not feasible. Results of experimental studies focusing on the extraction of thorium by mixed TBP-DBBP are included. S.C.W.

N65-31477# Bureau of Mines, Minneapolis, Minn.
SULFATIZATION OF NICKELIFEROUS LATERITES
Floyd E. Joyce, Jr. 1965 21 p refs
(RI-6644)

This report describes sulfatization of nickeliferous laterites from Puerto Rico and the Philippines for recovery of water-soluble nickel and cobalt sulfates. Temperatures ranging from 665° C to 710° C and a 10-percent sulfur dioxide-air reaction gas were employed during batch-roasting tests and during continuous countercurrent treatment in a 2-inch-diameter shaft furnace. A maximum of 69 percent of the nickel and 76 percent of the cobalt were recovered from one sample of Puerto Rican laterite, and a maximum of 96 percent of the nickel and 91 percent of the cobalt were recovered from the Philippine laterite. Author

N65-31481# Air Reduction Co., Inc., Murray Hill, N. J. Research and Engineering Dept.
RESEARCH ON APPLICATIONS OF RADIATION-INDUCED REACTIONS IN GASES Final Report
Arthur M. Feibush 12 Feb. 1965 57 p refs
(Contract AT(30-1)-3334)
(NYO-3334-1) CFSTI: $3.00

Two processes were developed for the laboratory scale production of wood–poly[vinyl chloride] composites by irradiation of wood impregnated with liquid vinyl chloride. In one method, the impregnation and irradiation are performed at room temperature under pressure. In the other the process is completed at −78° C and does not require the use of pressure vessels. Coloring agents may be introduced in either process to produce colored products. The radiation processed wood-poly[vinyl chloride] composites showed improved properties in comparison with untreated wood. Measurements of dimensional stability, compressive strength, flexural strength, hardness, abrasion resistance, chemical resistance, and fire resistance were made. The use of radiation processing for the formation of wood–polyethylene composites was also demonstrated. Radiation induced polymerization addition reactions were shown to occur in mixtures of unsaturated hydrocarbons with sulfur dioxide, ammonia, oxygen, and ammonia and oxygen. Author

N65-31513# Princeton Univ., N. J.
RAMAN SPECTRA OF CRYSTALLINE CH_4 AND CD_4
A. Anderson and R. Savoie Jul. 1965 21 p refs
(Contract Nonr-1858(27))
(TR-19; AD-617724)

The Raman spectra of crystalline CH_4 and CD_4 have been recorded in the temperature range 10–77° K, which includes all three solid phases of CD_4 and Phases I and II of CH_4. Only three of the four Raman active fundamentals were observed in all cases and no lattice vibrations were seen. There are marked changes in the spectra at the transition Phase I–Phase II, but only small differences between the spectra of Phases II and III of CD_4. The spectra of Phase I are very similar to that of the liquid, suggesting that molecular rotation persists in the crystal at temperatures near the melting point. The structure of the fundamentals in Phase II is best interpreted in terms of a D_{2d}^2 space group. The more detailed spectrum for Phase III of CD_4 may be indicative of a lower symmetry, but alternative explanations are briefly discussed. Author

N65-31540# Soreq Research Establishment, Israel Atomic Energy Commission, Rehovoth.
ACTIVITIES IN THE MOLTEN SILVER–SODIUM NITRATE SYSTEM
M. Liquornik and Y. Marcus Jun. 1964 12 p refs Presented at the 15th Meeting of C.I.T.C.E., London, Sep. 1964
(IA-941; Conf.-742-2)

The suggestion of Laity that mixtures of molten sodium and silver nitrates behave like regular solutions has been criticized. New potentiometric measurements were made over the complete mole fraction range and over a temperature range from the melting point of 400° C, and it is concluded that the excess entropy of mixing is not zero. Partial thermodynamic quantities were calculated from the data, and the enthalpy obtained compared with the reported calorimetric value. Author

N65-31543# Iowa State Univ. of Science and Technology, Ames.
PHASE DIAGRAMS OF THE SYSTEM THORIUM CHLORIDE–ALKALI CHLORIDES AND THORIUM CHLORIDE–EUTECTIC CHLORIDES
Seiichi Tanii [1964] 8 p refs Transl. into ENGLISH from J. Electrochem. Soc. (Japan), v. 32, 1964 p 167–170
(IS-TRANS-7)

The following phase diagrams for $ThCl_4$ electrolysis were obtained by differential thermal analyses: (1) The system $ThCl_4$–LiCl forms the crystal Li_4ThCl_8 at 452° C, and the eutectic point is 417° C in Li_4ThCl_8–$ThCl_4$ ($ThCl_4$ 35 mol/percent). (2) The system $ThCl_4$–NaCl forms Na_2ThCl_6 with a melting point around 435° C. The eutectic points for NaCl–Na_2ThCl_6–$ThCl_4$ are at 366° C ($ThCl_4$ 28 mol/percent) and at 397° C ($ThCl_4$ 44 mol/percent), respectively. (3) The system $ThCl_4$–KCl forms K_2ThCl_6 with a melting point around 715° C. The eutectic points for KCl–K_2ThCl_6 and K_2ThCl_6–$ThCl_4$ are 622° C ($ThCl_4$ 18 mol/percent) and at 432° C ($ThCl_4$ 52 mol/percent), respectively. The phase diagram for the multicomponent system of the eutectic mixture salts showed that the temperature for the $ThCl_4$ electrolysis bath can be reduced to 500° ~ 600° C. G.G.

N65-31568# Mound Lab., Miamisburg, Ohio.
NEW TECHNIQUES IN THE GAMMA ACTIVATION ANALYSIS OF BERYLLIUM
Harry L. Rook 13 Aug. 1965 8 p ref
(Contract AT(33-1)-GEN-53)
(MLM-1256) CFSTI: $1.00

The gamma activation method of analysis for total beryllium in beryllium metal, developed at Mound Laboratory, has been modified to make it a routine procedure. A five-gram sample of beryllium irradiated with antimony-124 gave a standard deviation due to counting statistics alone of ±0.12 percent at a 95 percent confidence level with two five-minute counts. The precision of the method, calculated from the deviation between duplicate analyses, was ±0.13 percent. The relative error at a 95 percent confidence level is ±0.26 percent. Author

N65-31578# Library of Congress, Washington, D. C. Aerospace Technology Div.
CHEMILUMINESCENCE IN THE LIQUID PHASE Translations of Soviet-Bloc Scientific and Technical Literature
Jerzy Kroh 10 Jun. 1965 335 p refs Transl. into ENGLISH from Acta Chim. Lodz. Towarz. Nauk. (Lodz), v. 5, no. 3, 1960 p 1–256
(ATD-T-65-38; AD-467427)

An investigation of the chemiluminescence process in the liquid phase is presented and includes a brief description of research and development in chemiluminescence up to the present; the most important groups of L-compounds and L-reactions; the mechanism and kinetics of chemiluminescence with emphasis on the oxidation of luminol and lucigenin; apparatus and experimental procedures in investigating chemiluminescence; the influence of catalysts, inhibitors, and medium on chemiluminescence; photoluminescence and chemiluminescence; and analytical applications of chemiluminescence. R.N.A.

N65-31592# Aerospace Corp., El Segundo, Calif.
REACTIONS OF NO_2 WITH METAL FLUORIDES
Richard S. Tunder 30 Sep. 1964 24 p refs
(Contract AF 04(695)-469)
(TDR-469(5210-10)-1; SSD-TDR-64-180; AD-451087)

Alkali metal fluorides react with NO_2 to form a stable metal fluoride · NO_2 complex which decomposes at elevated temperatures to yield OF_2, NO, and metal salts. It is shown that cesium fluoride forms the most stable NO_2 complex. The effect of temperature and solvents on the complexing reaction was investigated; hexafluorobenzene was found to be the best solvent. Manganese trifluoride and cupric fluoride complexes were found to yield OF_2 more readily than CsF complexes. Author

N65-31596# General Dynamics/Astronautics, San Diego, Calif.
CO-OXIDATION: I. INDUCTION PERIOD PRECEDING CO_2-FORMATION IN SHOCK HEATED CO–O_2–Ar MIXTURES
K. G. P. Sulzmann, B. F. Myers, and E. R. Bartle Nov. 1964 37 p refs
(Contract DA-04(495)-ORD-3383(Z); ARPA Order 393; Proj. Defender)
(GDA-DBE-64-061; GDA-DBE-64-002; AD-452241)

The initial reaction regime was investigated by using spectral portions of the CO-fundamental and CO_2-ν_3-fundamental infrared bands and spectral portions of the "CO-flame emission". An induction period has been observed which precedes the onset of measurable electronic ground state CO_2-formation and atomic oxygen production. The induction period is inversely proportional to the square roots of the initial mole concentrations of CO and O_2. The temperature dependence of the induction time for the initiation of CO_2-formation can be represented by an "apparent activation energy" which varies from 22 kcal/mole at 1500° K to 40 kcal/mole at 3000° K. Addition of 0.1% H_2 results in a decrease of the induction period and a decrease of "apparent activation energy" for the induction period. At temperatures above 2400° K, the contamination by hydrogenous species becomes negligible and the induction period is attributed to the mechanism

$$CO + O_2 \rightarrow CO_2 + O, \quad (I)$$
$$(M+) CO + O \rightarrow (M+) CO_2^*, \quad (II)$$
$$CO_2^* + O_2 \rightarrow CO_2 + 2O. \quad (III)$$

The rate constants for reactions (I) and (III) were determined to be approximately: $k_I \lesssim 6 \times 10^{12} \exp(-42\,000/RT)$ cm^3 mole^{-1} sec^{-1} and $k_{III} \approx 5 \times 10^{14} \exp(-38\,000/RT)$ cm^3 mole^{-1} sec^{-1}, respectively. Author

N65-31598# Auburn Univ., Ala. Dept. of Chemistry and Chemical Engineering.
A STUDY OF THE DECOMPOSITION MECHANISM OF AMMONIUM PERCHLORATE Final Report, 22 Feb. 1964–30 May 1965
James E. Land [1965] 65 p refs
(Contract DA-01-009-ORD-1023(Z))
(AD-466956)

Using differential thermal analysis technique peak temperatures for the crystal transformation and chemical decomposition of ammonium perchlorate of various particle sizes have been determined at heating rates of approximately 2, 4 and 10° C/minute. It was found that peak temperatures varied with the heating rate and such variation permitted the calculation of activation energies for the particular changes occurring at the respective peak temperatures. The influence of the nature and pressure of the atmosphere over the ammonium perchlorate during heating was investigated. Various materials function as catalysts on the decomposition of ammonium perchlorate and activation energies were measured with various additives present. The conclusion was reached that the lowering of peak temperature for the decomposition exotherm by the catalyst was a better criterion of its effectiveness than the change in activation energy. Author

N65-31606# Auburn Univ., Ala. Depts. of Chemistry and Chemical Engineering.
A STUDY OF THE DECOMPOSITION MECHANISM OF AMMONIUM PERCHLORATE Quarterly Progress Report, 1 Jul.–1 Oct. 1964
8 Oct. 1964 30 p
(Contract DA-01-ORD-1023(Z))
(QPR-2; AD-457947)

Progress is reported on the program to obtain data needed for the evaluation of activation energies, reaction orders, and mechanisms by differential thermal analysis (DTA) of the decomposition of ammonium perchlorate. Prior to the work on ammonium perchlorate, ammonium nitrate, benzoic acid, sodium nitrate, and silver nitrate were studied and the values compared to those from the literature. The determined values agreed within reasonable limits to those quoted in the literature. Fifty-two separate DTA runs were made on ammonium perchlorate samples at various heating rates and under either atmospheric pressure or partial vacuum. Data are presented; however, insufficient data has been collected to attempt to draw any conclusions. E.E.B.

N65-31608# Hercules Powder Co., Wilmington, Del. Research Center.
A STUDY OF THE ELECTRONIC CONFIGURATION AND BEHAVIOR OF THE $-NF_2$ GROUP Quarterly Report No. 9, 1 Mar.–1 May 1965
A. D. Craig and A. A. Albert 15 Jun. 1965 35 p refs
(Contract DA-31-124-ARO(D)-62; ARPA Order 402)
(HRC-65-2; AD-465139)

A research program directed toward a better understanding of the chemistry of nitrogen–fluorine species is summarized. Simple LCAO calculations on NF_3, HNF_2, CH_3NF_2, and N_2F_4 to estimate the energies of the lowest unoccupied and highest occupied molecular orbitals were studied. If feasible these calculations should give a good picture of the relationships among the electrochemical properties of various N–F compounds. The infrared spectrum of CF_3NF_2 was observed at high resolution. The interpretation was found to be most readily accomplished in terms of a structure in which the C–N bond and the two N–F bonds were coplanar. Preliminary experiments indicated that NF was generated by the dehydrofluorination of HNF_2 and appeared to be selective in its reactions. Evidence was obtained for the introduction of NF into hydrocarbon olefins. The interactions of NF with perfluoro olefins, SO_2, BF_3, CO, and NF_3 are also described. R.W.H.

N65-31634# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Materials Lab.
INVESTIGATION OF BASIC FACTORS INVOLVED IN THE FORMULATION AND CHARACTERIZATION OF ALUMINUM COMPLEX IMIDO ACIDS AS HIGH TEMPERATURE GREASE THICKENERS
Ernest L. Plummer Oct. 1964 28 p refs
(AFML-TR-64-324; AD-610248)

This report covers recent studies of aluminum salts of substituted benzoic acids for use as high temperature grease thickeners. It has been shown that although aluminum tribenzoate can be prepared by the reaction of aluminum isopropoxide with benzoic acid, it is hydrolytically unstable and, on exposure to moisture, hydrolyzes to aluminum dibenzoate monohydroxide. A literature survey on aluminum salts is included in addition to infrared and thermal gravimetric analysis data on the aluminum salts which have been prepared. Author

N65-31678# National Bureau of Standards, Washington, D. C.
FLUOROCARBON POLYMERS. POLYMERS OF PERFLUOROHEXADIENE, PERFLUOROHEPTADIENE, AND PERFLUOROOCTADIENE
James E. Fearn and Leo A. Wall Feb. 1965 20 p refs
(NBS-8623; AD-617256)

Perfluoro-1, 5-hexadiene, perfluoro-1, 6-heptadiene and perfluoro-1, 7-octadiene have been prepared and preliminary polymerization studies on the three monomers carried out. Preparation of certain new compounds, perfluoro-1, 6-heptadiene and some of its precursors, are reported for the first time. High pressure polymerization was successful in producing new polymers from these perfluorodienes. The polymers, however, were often insoluble and somewhat brittle. It is believed that trace impurities may be interfering with the polymerization process and causing crosslinking, and that greater efforts in purification of monomers must be made in order to obtain useful and thermally stable polymers. Author

N65-31689# United States Rubber Co., Wayne, N. J. Research Center.
POLYMERIZATION STUDIES LEADING TO HIGH STRENGTH CHEMICAL RESISTANT ELASTOMERS SERVICEABLE AT TEMPERATURE EXTREMES Semiannual Report, 30 Nov. 1964–31 May 1965
D. I. Relyea, H. P. Smith, and A. N. Johnson 15 Jun. 1965 14 p refs
(Contract DA-19-129-AMC-487(N))
(SAR-1; AD-466154)

Work was started toward the preparation of elastomeric materials having oil and chemical resistance, and useful rubbery properties over a wide range of temperatures (−65° to + 300°C). Apparatus was constructed for the vacuum train manipulation of 25-mmole quantities of fluoroolefin monomers. Several fluoroolefins were assayed; and a survey of potential catalysts for stereospecific polymerization of fluoroolefins was begun using hexafluoropropene and vinylidene fluoride as monomers. Tabulated data are shown. L.S.

N65-31695# Oak Ridge National Lab., Tenn.
THE RAPID DETERMINATION OF LOW CONCENTRATIONS OF OXYGEN AND HYDROGEN IN ALKALI METALS BY A MODIFIED AMALGAMATION TECHNIQUE
Gerald Goldberg [1964] 10 p Presented at the 8th Natl. Conf. on Anal. Chem. in Nucl. Technol. Gatlinburg, Tenn, 6–8 Oct. 1964
(Contract W-7405-ENG-26)
(ORNL-P-539; CONF-721-4)

The amalgamation method for the determination of oxygen in sodium consists of successi ive additions of mercury and the draining of the resulting sodium amalgam leaving only the unreactive NA_2O floating on the sodium-free mercury. Water is then added to the residual Na_2O and the resulting hydroxide solution is titrated with a standard acid to determine the stoichiometric amount of oxygen present. A modification is proposed to this method which is applicable to the routine determination of concentrations of oxygen of less than 50 ppm in potassium and NaK as well as in sodium. Also, hydrogen can be determined by refluxing the amalgam for several minutes within the reaction vessel. The hydrogen which is evolved is transferred to an evacuated sample bulb and quantitatively measured by gas chromatography. The amalgamation is then carried to completion for the subsequent determination of oxygen on the same sample. E.E.B.

N65-31696# Argonne National Lab., Ill.
INVESTIGATION OF FUSED-SALT PROCESSES FOR THE PREPARATION OF URANIUM SULFIDES
D. R. Messier Mar. 1965 14 p refs
(Contract W-31-109-ENG-38)
(ANL-7008) CFSTI: $1.00

Attempts were made to prepare uranium monosulfide by two fused-salt processes. The first consisted of bubbling a H_2–H_2S stream through molten alkali halides containing

dissolved UF_4. In the second, UF_4 or UCl_4 with various sulfides was electrolyzed in fused chloride media. Mixtures of UOS and UO_2 were obtained by the bubbling method under uncontrolled drying conditions. No product was obtained when careful drying was done. Under the driest electrolysis conditions, UOS was obtained. It was concluded that the monosulfide cannot be produced by the gas reaction method, and that improved experimental conditions would be necessary for success with the electrolytic method. Author

N65-31699# Sandia Corp., Albuquerque, N. Mex. Sandia Lab.
PHYSICAL PROPERTIES OF FUSED SALE MIXTURES Data From Open Literature, 1907–1962
Paul V. Clark 15 Jun. 1965 298 p refs
(SC-R-65-930, Vol. I) CFSTI: $7.00

The data under study consist of a list of fused salt mixtures with eutectic compositions and melting points. The composition of all systems is reported in mole %. In some cases equivalent % was reported, yet the formula was written as a multiple of the empirical formula. A complete list of references is included so that the original literature may be consulted. A coordinate index is also included for rapidly locating system components and systems covered. R.W.H.

N65-31704# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MASTERING OF INACCESSIBLE ELEMENT
I. L. Knunyants and A. V. Fokin 6 Apr. 1965 194 p refs Transl. into ENGLISH of the book "Pokoreniye Nepristupnogo Elementa" Moscow, Izd. Akad. Nauk SSSR, 1963 p 1–192
(FTD-MT-64-186; AD-617663)

The history of fluorine chemistry and of the important inorganic and organic compounds of fluorine is reviewed in detail. The individual chapters of this text consider the following: *Fluorine and Some of Its Inorganic Compounds; Organic Derivatives of Fluorine; Teflons; Fluororubbers; Lubricating Materials and Separating Liquids; Freons;* and *Dyes, Medicinals, and Toxic Substances.* E.E.B.

N65-31714# Bureau of Mines, Rolla, Mo. Rolla Metallurgy Research Center.
HYDROGEN REDUCTION OF GALENA AND SPHALERITE
J. D. Spagnola 1965 21 p refs
(BM-RI-6662)

The Bureau of Mines conducted research to obtain comparative data on the extent of reduction of galena and sphalerite with molecular hydrogen and with hydrogen from the thermal cracking of ammonia and methane at various time intervals. Galena reductions of 95 to 99 percent were obtained with H_2 and with decomposed NH_3, while reductions of 70 to 80 percent were obtained with cracked CH_4. Sphalerite reductions of 99 percent were obtained at 1000° C with H_2 and with decomposed NH_3; however, complete volatilization of the free zinc from the remaining concentrate and the subsequent recombination of zinc and sulfur vapors resulted. A promoted iron catalyst brought about a decrease of 100° C in the temperature required for complete decomposition of ammonia. It was found that H_2S retards NH_3 decomposition and that nitrogen retards the reduction of galena by H_2. A mixture of N_2 and H_2 in about the same ratio as that obtained by the thermal cracking of NH_3 gave about 15 percent less reduction of galena than was obtained with decomposed NH_3; this indicates that a portion of the hydrogen obtained by NH_3 decomposition is in an active form. Author

N65-31722# Oak Ridge National Lab., Tenn. Isotopes Development Center.
THE USE OF AN ION EXCHANGE RESIN AS THE AQUEOUS PHASE CARRIER IN PARTITION CHROMATOGRAPHY. THE SEPARATION OF Zn, Cd, AND Hg [PRIMENENIE IONOOBMENNYKH SMOL KAK NOSITELEI VODNOI FAZY RASPREDELITEL'NOI KHROMATOGRAFII: RAZDELENIE Zn, Cd, I Hg]
L. N. Moskvin, B. K. Preobrazhenskii, and L. N. Rzhanitsyna Oct. 1964 10 p refs Transl. into ENGLISH from Radiokhimiya (USSR), v. 5, no. 3, 1963 p 299–304
(ORNL-TR-300)

The possibility of chromatographic separations by solvent extraction was demonstrated by stabilization of the aqueous phase on an ion exchange resin. In the process the electrolytes were retained primarily in the hydrated film surrounding the resin particles. The composition of the film can be controlled by preliminary treatment of the column. Also, a method for separating zinc, cadmium, and mercury was devised. In order to separate these elements, selection of the immovable aqueous phase was determined by the fact that only mercuric ion is noticeably extracted by diethyl ether at low HBr concentrations. Diethyl ether saturated in water was used to elute mercury. On passing eight free column volumes of ether not saturated with HBr through the column, the amount of HBr in the aqueous resin phase decreased from 28 to 11 mg/gm of resin. This behavior assures the rapid elution of mercuric ion which is extracted at lower HBr concentrations. The zinc is eluted with ether saturated with HCNS. The cadmium remaining on the column is eluted with 1 N HBr. E.E.B.

N65-31726# Atomics International, Canoga Park, Calif.
PACKLESS COLD TRAP EVALUATION
G. N. Lauben 17 Jun. 1964 10 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-9920)

The performance of four cold traps of advanced packless design are evaluated. A discussion of precipitation and crystallization theory and its application to a sodium–sodium oxide system is presented. Packed and packless trap performance is compared. Cold trap analytical methods are presented. A test program for the packless trap and design improvements for future traps are recommended. R.N.A.

N65-31727# New South Wales Univ., Kensington (Australia). Dept. of Nuclear and Radiation Chemistry.
GAMMA-IRRADIATION OF URACIL IN DE-AERATED AQUEOUS SOLUTIONS
M. N. Khattak and J. H. Green [1964] 7 p refs
(NRS-22)

Pyrimidine bases were irradiated in 5 ml de-aerated solutions with Co^{60} gamma radiation. The dose rate was about 1000 rads per minute for a total dose of 10^5 to 10^6 rads. The irradiated solutions were then analyzed by descending paper chromatography. Ultraviolet-absorbing products were located by viewing the chromatograms in ultraviolet light. The pyrimidines saturated at the 5–6-double bond were found by spraying the chromatograms with 0.5N sodium hydroxide followed by a solution of para-dimethylaminobenzaldehyde. The experimental observations are explained by the degradation of Uracil in de-aerated aqueous solution. The experiments were repeated while irradiating 2-C^{14}-Uracil solution. The developed chromatograms were scanned under a Geiger counter connected with a ratemeter and recorder. Six different radioactive spots were located on the papers. A typical scan is shown. E.E.B.

N65-31729# California Univ., Livermore. Lawrence Radiation Lab.
THE PROBLEM OF EXCESS OXYGEN IN NICKEL OXIDE

Hartmut Gossel May 1964 13 p refs Transl. into ENGLISH from Z. Elektrochem. (Weinheim), v. 65, 1961 p 98–102
(UCRL-TRANS-1074(L))

The nickel oxide–oxygen system was investigated to discover an explanation for the appearance of different superstoichiometric amounts of oxygen in differently prepared nickel oxides but with similar lattices. It was found that nonstoichiometry of the nickel oxide, at least to an overwhelming extent, is a property of the surface or near surface region of the compound. This information is of importance in explaining chemisorption and contact properties of nickel oxide and in interpreting the closely related semiconductor properties. It contradicts the previous existing assumption that nonstoichiometry of nickel oxide is essentially a volume property. E.E.B.

N65-31732# General Dynamics Corp., San Diego, Calif. General Atomic Div.
ADVANCES IN NEUTRON ACTIVATION ANALYSIS
Vincent P. Guinn [1965] 10 p refs
(A/Conf-28/P/197)

New and better equipment and techniques in neutron activation analysis have increased its capabilities and its areas of useful application. The widespread use of the small neutron generator, coupled with the purely instrumental form of the method, is enabling the method to be employed at the minor and major constituent element levels. In the trace level field, the method has advanced using high flux research reactors with special provisions for efficient neutron activation analysis work, high intensity reactor pulses, and effective use of reactor fast neutrons. The principal areas of improvement in equipment, techniques, and applications in the physical sciences are discussed. R.N.A.

N65-31740# Pennsylvania State Univ., University Park. Dept. of Chemistry.
STUDY OF HIGH TEMPERATURE PROPERTIES OF TRANSITION METAL PHOSPHIDES AND RELATED REFRACTORY MATERIALS Final Report, 1 Apr. 1960–31 Oct. 1964
Karl A. Gingerich [1964] 14 p refs
(Contract AT(30-1)-2541)
(NYO-2541-1)

The preparation, constitution, crystal chemistry, thermal stability, and selected properties of the transition metal phosphides were investigated. Emphasis was placed on the study of the titanium and zirconium phosphides since these compounds were expected to combine high temperature stability and resistance to chemical attack. Also, because of their nuclear potential, uranium and thorium phosphides were studied in detail after recognition of their high chemical and thermodynamic stability. In search for suitable oxygen-free container materials, the phosphides of tungsten, molybdenum, and rhenium were also studied. This work has led to the recognition of transition metal phosphides as a new group of oxygen-free refractory materials. The monophosphides or uranium and thorium are of particular interest in high temperature nuclear fuel technology. These phosphides combine high melting points and low vapor pressures with a chemical resistance superior to that of other oxygen-free refractory materials. Zirconium monophosphide appears to be the most promising compound for nuclear technology applications because of its high stability, low neutron absorption, and high oxidation resistance. E.E.B.

N65-31741# Cornell Univ., Ithaca, N. Y.
ROTATIONAL DEGREES OF FREEDOM OF LATTICE DEFECTS IN SOLIDS
Venkatesh Narayanamurti 14 Sep. 1964 10 p refs *Its* Rept.-254
(Contract AT(30-1)-2391)
(NYO-2391-3)

The rotational degrees of freedom model introduced by Linus Pauling for the case where a molecule is introduced substitutionally into a solid lattice is verified experimentally. This model proposes that molecules in solids perform librational motion, hindered rotation, and free rotation at different temperature levels. Spectroscopic data were obtained for cyanide ions in single crystals of KCl and KBr at temperatures ranging from 2 to 60° K. Analysis of the data completely verify the Pauling model. It is concluded that whether a foreign molecule can perform a free rotation in a lattice is determined by the barrier height and the temperature, and it appears that the barrier height is small enough for many defect systems to make free rotation observable even at low temperatures. J.M.D.

N65-31749# Bureau of Mines, Albany, Oreg. Albany Metallurgy Research Center.
EXTRACTION OF TANTALUM AND COLUMBIUM FROM ORES AND CONCENTRATES BY CHLORINATION
Sherman L. May and G. T. Engel 1965 12 p refs
(BM-RI-6635)

Tantalum and columbium can be extracted from several of their ores or concentrates by chlorination procedures. Direct chlorination of high-grade minerals in the presence of carbon at temperatures between 500° and 800° C will extract up to 99 percent of the tantalum and columbium. Metallurgical beneficiation of low-grade source materials by carbothermic reduction produces a ferroalloy that is amenable to chlorination at a temperature of 500° C. Over 90 percent of the tantalum and columbium can be recovered. Author

N65-31755# California Univ., Livermore. Lawrence Radiation Lab.
OSCILLOGRAPHIC BEHAVIOR AND DETERMINATION OF RUTHENIUM AND OSMIUM
Premyzl Beran, Milos Burian, and Jan Dolezal (Charles Univ., Prague) Sep. 1964 13 p Transl. into ENGLISH from J. Electroanal. Chem., v. 4, 1962 p 105–115
(UCRL-TRANS-1117-L)

Results are summarized for the investigation of the oscillopolarographic behavior of osmium and ruthenium in a large number of different base electrolytes. In solutions of 1 molar ammonium thiocyanate and 1 molar potassium thiocyanate ruthenium and osmium produce no appreciable crevasses. In 1 molar potassium chloride, 1 molar triethanolamine, 0.25 molar ethylenediamine, and 0.5 molar sodium nitrate solutions only osmium exhibits the characteristic crevasses. The solutions best suited for detecting and determining osmium in the presence of ruthenium are 0.25 molar ethylenediamine and 0.5 molar sodium nitrate. Osmium can be detected also in the presence of ruthenium with 1 molar sodium hydroxide or a mixture of 0.5 molar sodium hydroxide and 0.5 molar triethanolamine. Also, in 1 molar hydrochloric acid, osmium forms a sensitive cathodic crevasse. Ruthenium is also detectable by a cathodic crevasse in this medium. In 1 molar nitric acid only osmium forms a crevasse. E.E.B.

N65-31756# United Kingdom Atomic Energy Authority, Windscale (England). Production Group.
ANALYTICAL METHOD FOR THE DETERMINATION OF SULPHUR IN CARBON DIOXIDE
1964 7 p
(PG-623(W)) HMSO: 1s 2d

Carbon dioxide and oxygen are passed at known flow rates over silica chips at 1200° C. Compounds containing sulfur are pyrolyzed to sulfur dioxide which is absorbed in sodium tetrachloromercurate. Fuchsin and formaldehyde are added and the sulfur present is determined absorptiometrically as the sulfonic acid derivative of fuchsin. The method is intended for the determination of the total sulfur in the carbon dioxide

feed gas or circuit gas of gas cooled reactors. The concentration range for the method is 0.1 to 5 ppm of sulfur in carbon dioxide. The only known interference is from nitrogen dioxide.
E.E.B

N65-31762# Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria). Institut für Chemie.
IMPROVEMENT OF THE REPRODUCIBILITY OF THE FALLING-DROP METHOD BY INCLINATION OF THE TUBE [VERBESSERUNG DER REPRODUZIERBARKEIT DER TROPFENFALLMETHODE DURCH SCHRAGSTELLEN DES FALLROHRES]
E. Proksch, H. Bildstein, H. Eschweiler, and F. Wiesinger [1964] 8p refs In GERMAN; ENGLISH summary Submitted for Publication
(SGAE-CH-6-1964)

The falling-drop method for the density determination of aqueous solutions or for the isotopic analysis of water is discussed. A method is presented for improvement in the reproducibility of results by using an inclined rather than a vertical tube. Instead of falling freely, the drops roll down the wall of the inclined tube. If the wall surface is sufficiently flat and uniformly coated with water, the drops are guided in their path and are less susceptible to perturbations by liquid motion.
E.E.B.

N65-31770# United Kingdom Atomic Energy Authority, Springfields (England). Production Group.
ANALYTICAL METHODS FOR THE ANALYSIS OF URANIUM MONO AND DICARBIDES (THE DETERMINATION OF IRON, NICKEL AND MOLYBDENUM)
1964 18 p refs
(PG-516) HMSO: 5s

Two methods are given for the absorptiometric determination of iron, the first using 1-10-0-phenanthroline for iron contents below 50 p.p.m. and the second using thioglycollate for higher ranges of iron contents. Nickel is determined absorptiometrically with dimethylglyoxime, the complex being first isolated by chloroform extraction and then re-extracted into an acidic aqueous phase. Toluene-3,4, dithiol is used as the reagent for the absorptiometric determination of molybdenum, the complex being extracted into carbon tetrachloride from an aqueous solution whose acidity is controlled for optimum complex formation.
Author

N65-31803# Iowa State Univ. of Science and Technology, Ames.
THE REDUCED CELL AND ITS CRYSTALLOGRAPHIC APPLICATIONS
Stephen L. Lawton and Robert A. Jacobson Apr. 1965 209 p refs
(Contract W-7405-ENG-82)
(IS-1141) CFSTI: $6.00

This report describes the reduced cell and its applications to structural crystallography. Typical applications which are discussed are its use as the standard choice of the unit cell in a triclinic lattice and the use of its scalars in identifying in a lattice the cell of highest symmetry. The report also describes two FORTRAN computer programs which may be used to locate the reduced cell in a lattice, to calculate its parameters and to derive the matrix for the transformation of the original cell to the reduced cell.
Author

N65-31808# United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.
A COMPARISON OF ^{240}Pu AND ^{109}Ag AS EPITHERMAL INDEX MONITORS FOR LONG IRRADIATIONS
M. J. Cabell and M. Wilkins Apr. 1965 33 p refs
(AERE-R-4866) HMSO: 4s 6d

The use of silver monitors to measure Westcott's epithermal index parameter, $r\sqrt{T/T_o}$, during long irradiations in high neutron fluxes is described, and the mathematical expressions necessary are given. The performance of silver and ^{240}Pu monitors are compared in irradiations of two months duration and an integrated neutron flux of up to 5.6×10^{20} neutrons per cm^2. Results using the two monitors are in agreement within the limits of error (about ±12 percent in each case). Nevertheless silver monitors are to be preferred, not only because they are much simpler to use, but also because they need relatively little development to be made capable of yielding still more precise results.
Author

N65-31821# Army Chemical Center, Edgewood, Md. Chemical Research and Development Labs.
SEVENTEENTH MATERIALS REVIEW
Arthur Lyem Apr. 1965 97 p refs
(CRDL-SP-5-7; AD-463490)

This report presents important new technical and scientific information about materials research here and abroad, principally in the polymer and plastics fields. Information about recent technological advances is presented under five major headings: (1) high polymers (2) plastic materials, (3) synthetic fibers, (4) miscellaneous organic and inorganic compounds, and (5) metals and alloys. Over 300 articles were abstracted from various publications and languages. Materials and technological aspects are discussed, and each abstract is numerically keyed to its reference in the bibliography.
Author

N65-31822# Vanderbilt Univ., Nashville, Tenn.
INTERPRETATION OF NEAR AND VACUUM ULTRAVIOLET BAND SPECTRA Quarterly Technical Summary Report No. 2, 1 Sep.-30 Nov. 1964
K. Keith Innes [1964] 6 p refs
(Grant DA-ARO(D)-31-124-G544; ARPA Order 40)
(AD-463591)

The second band system of the BOF_2 molecule spectrum was obtained under improved conditions so that the fine structure can be measured more accurately. It was also photographed using $^{10}BF_3$–$^{16}O_2$ and $^{10}BF_3$–$^{18}O_2$. From the latter experiments, it was tentatively concluded that these ultraviolet bands do not arise BOF_2. In the BO_2 molecule spectrum, progress was made with rotational analysis of the $^{10}BO_2$ green bands. As a result, the vibrational assignment for $^{10}BO_2$ and $^{11}BO_2$ are becoming clearer. Efforts to find spectra attributable to the N–F, S–F, and O–F molecules have so far failed. A new vacuum ultraviolet band system of the B–Cl molecule is being photographed at high resolution. A new predispersion system is making high order studies possible.
R.N.A.

N65-31823# Sussex Univ., Brighton (England). Chemical Lab.
AMMONIA COMPLEXES OF ETHYLALUMINIUM CHLORIDES
M. Cohen, J. K. Gilbert, and J. D. Smith Apr. 1964 29 p refs
(Grant AF-EOAR-63-104)
(SR-1; AD-463596)

Ethylaluminium dichloride forms complexes with one, two, five and eight moles of ammonia and diethylaluminium chloride gives adducts with one and two moles of ammonia per aluminium. No evidence has been found for ammonolysis of aluminium–chlorine bonds. On heating the complexes lose ethane with the formation of aluminium–nitrogen polymers, and in certain conditions aluminium trichloride–ammonia is formed in a reorganization reaction.
Author

N65-31840# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry.
MOLECULAR ASYMMETRY OF OLEFINS III. OPTICAL STABILITY OF TRANS-CYCLONONENE AND TRANS-CYCLODECENE
Arthur C. Cope, K. Banholzer, Hannelore Keller, Beverly A. Pawson, J. J. Whang et al [1965] 26 p refs
(Grant DA-ARO(D)-31-124-G404)
(AROD-1112-21; AD-464340)

Resolution of trans-cyclononene was accomplished by the method previously used in the resolution of trans-cyclooctene. It was found that trans-cyclononene racemized spontaneously at room temperature at such a rate that no optical activity could be observed when the olefin was recovered from the pure diastereoisomeric platinum complexes by the procedure which yielded optically active trans-cyclooctene. When the recovery was performed by a fast reaction at room temperature and the rotation of the olefin was measured below 0° C, optical activity was observed and rates of racemization could be measured. The trans-cyclodecene recovered from pure diastereoisomeric platinum complexes under these conditions was optically inactive. E.E.B.

N65-31861# Florida Univ., Gainesville. Dept. of Chemistry.
RESEARCH ON SYNTHESIS OF UNSATURATED FLUOROCARBON COMPOUNDS Semiannual Report, 1 Oct. 1964–31 Mar. 1965
Paul Tarrant, Doug Perry, Jai Tandon, Alan Wright, and Susumu Misaki [1965] 39 p refs
(Contract DA-19-129-AMC-79(N))
(SAR-4; AD-465104)

A study has been made of methods for producing perfluoroallyl bromide and iodide. The latter olefin reacted with alcohols to produce ethers such as $CF_3CH_2OCF_2CF{=}CF_2$. The reaction of haloethylenes and haloalkanes in the presence of Lewis acids has been studied and variations from the literature have been noted. Attempts to prepare $(CF_2{=}CFCH_2CH_2CH_2)_2O$ from the allyl ethers have been carried out but cyclic ethers were formed. An investigation of the radical addition of $CF_3CF_2CCl_3$, $CF_2ClCF_2CCl_3$, CFClBrCFClBr and $CCl_3CF_2CFClBr$ with various olefins has been initiated. Studies of the preparation of perfluoroalkane epoxides have also been initiated. Author

N65-31878# Eidgenossische Technische Hochschule, Zürich (Switzerland).
CLARIFICATION OF POLYMER CONSTITUTION USING PRECIPITATION POINT TITRATION [KONSTITUTIONSAUFKLARUNG VON POLYMEREN DURCH FALLUNGSPUNKTTITRATION]
Urs Gruber (Ph.D. Thesis) 1964 102 p refs In GERMAN
(Prom.-3511)

Described is a titration procedure that employs the difference in solubility to separate polymers and copolymers of similar chemical overall composition, but with different microstructures. This precipitation point titration technique found polystyrol concentrations of 1, 4, and 8 percent in a styrol-isopropylstyrol-copolymer mixture. Transl. by G.G.

N65-31904# United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.
THERMOCHEMISTRY AND NUCLEAR ENGINEERING
M. H. Rand and L. E. J. Roberts [1965] 32 p refs
(SM-66/29)

Various applications of thermochemical data and concepts to the practical problems that arise in developing nuclear power for civilian uses are summarized. It is pointed out that accurate phase diagrams for all classes of compounds are vital for predicting the limits between which different materials can be used, and for production control. Chemical stability and compatibility of materials, high temperature equilibria, ternary phases, effects of radiation damage on phase stability, transmutation effects, and fluid phases are other areas in which the use of thermodynamic and thermochemistry concepts are discussed. It is suggested that even when incomplete data do not permit confident prediction, analysis of experimental data based on these concepts can prove valuable in assessing the reliability of extrapolation to practical conditions. M.G.J.

N65-31908# United Kingdom Atomic Energy Authority, Risley (England). Engineering Group.
'ON LINE' GAS ANALYSIS
K. C. Hignett May 1965 50 p refs
(EG-36(R)) HMSO: 12s 6d

The aim of this report is to present the subject of Continous Gas Analysis as applied to chemical processing and nuclear reactor systems. The case for the on line method is discussed and is followed by considerations of various principles on which selection of the adequate system may be based. Some sampling techniques and their associated problems are examined. Finally the operating principles and performance of the more common analysis systems are explained. Author

N65-31909# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucléaires.
MEASUREMENT OF SMALL SURFACES BY THE BET ADSORPTION METHOD. [MESURE DES FAIBLES SURFACES PAR LA METHODE D'ADSORPTION B.E.T.]
P. Chènebault and A. Schürenkämper (EURATOM) Brussels, EURATOM, Mar. 1965 25 p refs In FRENCH
(Contract EURATOM-031-60-10RDF)
(EUR-2012.f; EURAEC-1177)

An adsorption method for measuring surface areas of a few cm^2 is presented. This method was developed for measuring krypton and xenon diffusion formed by the nuclear fission of uranium dioxide. A mixture of natural xenon and xenon-133 is used as the adsorbate. Charts and tables, describing the results, in addition to a discussion of the method are included. Transl. by G.A.L.

N65-31917# European Atomic Energy Community, Brussels (Belgium).
END-POINT CALCULATION OF THE BORIC ACID POTENTIOMETRIC TITRATION CURVE [CALCUL DE LA POSITION DU POINT FINAL DE LA COURBE DE TITRATION POTENTIOMETRIQUE DE L'ACIDE BORIQUE]
Y. Le Duigou 1965 6 p refs In FRENCH; ENGLISH summary
(EUR-2240.f) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 25 Belg. Fr.

A calculation indicating the localization of the inflexion point of a potentiometric titration curve has been applied to the boric acid determination previously described. Experimentally determined datas were used for this calculation. The result shows that that the inflexion point of the titration curve coincides with the theoretical equivalent point to better than 0.01%. Author

N65-31928# European Atomic Energy Community, Brussels (Belgium).
THE FLUORESCENCE OF p-HYDROXYDIPHENYL IN AQUEOUS SOLUTION
P. Scoppa and K. Gerbaulet 1965 19 p refs
(EUR-2423.e) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 40 Belg. Fr.

p-Hydroxydiphenyl shows fluorescence not only in the known alkaline pH range, but also in the neutral and acidic range. The characteristics of the excitation-fluorescence spectra as well as their modification by several factors, are described. Author

N65-31950*# Stanford Research Inst., Menlo Park, Calif.
STUDY OF GROWTH PARAMETERS FOR REFRACTORY CARBIDE SINGLE CRYSTALS Quarterly Status Report No. V, Mar. 1–Jun. 1, 1965
R. W. Bartlett, W. E. Nelson, E. Carr, and F. A. Halden 6 Jul. 1965 34 p refs
(Contract NASr-49(19); SRI Proj. PMU-4892)
(NASA-CR-64323) CFSTI: HC $2.00/MF $0.50 CSCL 11F

The three electrode ac arc melting furnace for melt growth of crystals was assembled and tested. Crystal growth experiments and solubility experiments for solution growth of TaC were performed. Thermodynamic and kinetic factors affecting the selection of systems for solution growth of TaC were analyzed. Moderately low solubility solvents are desired when excess free carbon and tantalum are present in the melt system. This is necessary to limit the degree of supersaturation with respect to equilibrium with TaC. Excessive supersaturation causes uncontrolled nucleation and leads to rapid precipitation of many small crystals rather than growth of a few large crystals. When excess free tantalum and carbon are absent from the melt system and another TaC sample is used as the nutrient, chemical activities of carbon and tantalum in the solution in equilibrium with the nutrient are diminished. Solvents with low activity coefficients are required to compensate for low activities and keep the carbon and tantalum concentration at an adequate level. If the reactant concentrations are too low, solution diffusion will be too slow and crystal growth rates will be retarded. R.N.A.

N65-31977# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
A TOTAL BURN SPECTROGRAPHIC DETERMINATION OF SILICON IN PLUTONIUM
Roy Ko Jul. 1965 10 p refs
(BNWL-99)

A total burn-spectrographic method has been applied to the determination of trace concentrations of silicon in plutonium. The sample is oxidized to plutonium dioxide, mixed with a germanium dioxide–graphite mixture containing tin internal standard, packed into cupped graphite electrodes, and burned to completion in a high amperage direct current arc. Plutonium spectral interference is minimized by optical means and by use of a less intense silicon line. The sensitivity is thereby decreased but is still sufficient to determine 25 ppm of silicon in plutonium. The precision of the method is estimated to be ±8% (relative standard deviation) at the 270 ppm level and ±14% at 40 ppm. Author

N65-31979# Centre National de la Recherche Scientifique, Paris (France). Centre d'Etudes de Chimie Metallurgique.
FLUORITE-TYPE STRUCTURAL PHASE MODIFICATIONS IN SYSTEMS HAVING A ZIRCONIUM OR HAFNIUM OXIDE BASE
Jean Lefevre (Ph.D. Thesis, 1962) Repr. from Ann. Chim. (Paris), v. 8, 1963 p 117–149 refs
(ORNL-TR-201)

Various structural modifications of fluorite and its relationships with apparent scheelite or Mn_2O_3 structures were studied. The allotropic monoclinic–quadratic transformation was studied by dilatometry and thermal differential analysis on pure zirconium oxide and various solid dilute solutions of a zirconium oxide base. The quadratic-cubic evolution of the structure of solid dilute M_2O_3 oxide solutions in zirconium oxide was made continuously at high temperature. The structural fluorite–scheelite transition in the germanium zirconium oxide and germanium hafnium oxide systems was achieved by means of a new phase which is written as Zr_3GeO_8 or Hf_2GeO_8. The fluorite Mn_2O_3 (IV) structural transition in the scandium zirconium oxide system was made by means of three phases β, γ, and δ of very similar structures. These structures were studied and were all based on the fluorite system. A mechanism for the reaction for forming solid solutions by coprecipitation in the amorphous state was also studied. C.T.C.

N65-31983# Bureau of Mines, Albany, Oreg.
ELECTRON-BEAM MELTING OF YTTRIUM
W. E. Anable and R. A. Beall 1965 18 p refs
(BM-RI-6661)

The Bureau of Mines studied the purification of commercially available yttrium by melting it in a 100-kw electron-beam furnace. Button-scale melts were made to determine the ultimat purification that could be attained by melting yttrium at 1,733° to 1,770° C at low pressure (0.05 to 0.1 micron) for 1 to 120 minutes. In addition, numerous melts were made to study the effect of doping yttrium with carbon. 17 selected metallic additions, and 3 compounds. Except for nickel and zirconium, the metallic impurities in yttrium were lowered significantly on extended treatment; silicon was lowered only slightly. The nonmetallic impurities, oxygen, nitrogen, and carbon, were not lowered except on short exposures. In isolated instances, the oxygen content was lowered from 5,860 ppm to about 5,000 ppm. In most instances the carbon content was lowered from 545 to about 220 ppm in 20 minutes and then increased again. It was concluded that yttrium cannot be purified by direct heating or by the doping technique employed. Author

N65-32077*# National Bureau of Standards, Washington, D. C.
A SURVEY OF THERMODYNAMIC PROPERTIES OF THE COMPOUNDS OF THE ELEMENTS CHNOPS Progress Report, 1 Feb.–30 Jun. 1965
George T. Armstrong, Eugene S. Domalski, May N. Inscoe, Iva Halow, George T. Furukawa et al 1 Jul. 1965 90 p refs
(NASA Order R-138)
(NASA-CR-64447; NBS-8906) CFSTI: HC $3.00/MF $0.75 CSCL 07D

Heat capacities, entropies, enthalpies, and free energies of the compounds of carbon, hydrogen, nitrogen, oxygen, phosphorus, and sulfur are considered. Changes in enthalpy and in free energy are also studied in these reactions. The substances and their physical states on which thermodynamic data have been found are listed along with the temperature range of the heat measurements. Tables are included for (1) selected heats of combustion and heats of formation of certain organic compounds, (2) free energies of formation of certain amino acids, and (3) compounds of C, H, N, O, P, and S which contain not more than one C atom per molecule. C.T.C.

N65-32078*# Midwest Research Inst., Kansas City, Mo.
SYNTHESIS AND EVALUATION OF NEW HIGH POLYMERS FOR COATING APPLICATIONS Annual Summary Report No. 1, 26 Jun. 1964–25 Jun. 1965
L. W. Breed, W. H. Burton, R. L. Elliott, and L. M. Mc Donough [1965] 112 p refs
(Contract NAS8-11338)
(NASA-CR-64448) CFSTI: HC $4.00/MF $0.75 CSCL 07C

Experimental work is reported on the synthesis of organic and semiorganic polymers useful as coatings that will withstand high temperatures, high vacuum, and radiation. Attempts to prepare titanium chelate polymers, titanoxanosiloxanes, and borosiloxanes produced only low molecular weight products. An investigation of model systems for ferrocene polyesters and boron chelate polymers did not reveal any potentially useful methods of polymerization. High molecular weight poly(benzoxazoles) were prepared, but no satisfactory method was found for preparing poly(benzoxazole)films. A poly(phenylenesiloxane) with good film forming properties was prepared and screened

under high vacuum-ultraviolet irradiation conditions. The more promising polymers were characterized by solution viscosity, elemental analysis, differential thermal analysis, thermogravimetric analysis, and solubilities. Author

N65-32100# Atomics International, Canoga Park, Calif.
KINETICS OF THE REACTION OF URANIUM MONOCARBIDE WITH WATER
L. J. Colby, Jr. 25 Jul. 1965 16 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-11401) CFSTI: $1.00

The rate of hydrolysis of uranium carbide from 30 to 86.2° C was measured by a constant volume technique. An activation energy of 17.6 kcal/mole of UC was obtained from an Arrhenius plot of the data. The hydrolysis reaction rate at 70° C was found to be proportional to the square root of the water concentration when 2-propanol was used as a diluent. It is, therefore, postulated that the rate-determining step in the hydrolysis of uranium carbide involves the breaking of an O-H bond. Author

N65-32105# India. Dept. of Atomic Energy, Bombay.
UNIT FOR TESTING HIGH EFFICIENCY FILTERS
P. Kotrappa, G. S. Jauhri, and S. K. Dua 1965 25 p refs
(AEET/202)

A unit which uses sodium-24 as a tracer has been developed to test high efficiency ventilation filters used in radioactive installations. The test aerosols consist of 0.2 microm MMD particles produced by an aerosol generator which uses 5% activated sodium chloride solution. The method of testing consists in isokinetic sampling of air for radioactivity up stream and down stream of the test filter using inline samplers. A study of variation of penetration with velocity indicated no appreciable change when the face velocity was varied from 20 FPM to 275 FPM. Detailed evaluation of the method for reproducibility, sensitivity and associated hazards has been made. Author

N65-32137# Battelle-Northwest, Richland, Wash.
THE FORMATION OF CHEMICALS BY REACTOR IRRADIATION OF OXYGENATED WATER AND AMMONIATED WATER
W. K. Winegardner Jul. 1965 21 p refs
(Contract AT(45-1)-1830)
(BNWL-82)

Tests were conducted with two experimental facilities in the Hanford production reactors to gain insight into the formation of chemicals by reactor radiation. The tests consisted of the exposure of flowing dilute aqueous solutions to reactor radiation, primarily gamma rays and fast neutrons. The formations of hydrazine in ammoniated water and hydrogen peroxide in oxygenated water were studied. The maximum hydrazine concentration observed, 450 ppb, was associated with an 850 ppm ammonia concentration, the highest reactant stream concentration used. The maximum concentration of hydrogen peroxide observed, 300 ppm, resulted from the addition of oxygen to demineralized water. Author

N65-32175*# National Aeronautics and Space Administration, Washington, D. C.
INTERACTION OF THE DIBORIDES OF TITANIUM, ZIRCONIUM, AND HAFNIUM WITH CARBON [VZAIMODEYSTIVIYE DIBORIDOV TITANA, TSIRKONIYA I GAFNIYA S UGLERODOM]
Yu. V. Levinskiy and S. Ye. Salibekov Jul. 1965 9 p refs
Transl. into ENGLISH from Zh. Neorg. Khim. (Moscow), v. 10, no. 3, 1965 p 588-591
(NASA-TT-F-9506) CFSTI: HC $1.00/MF $0.50 CSCL 07B

The extent to which the compositions of TiB_2, ZrB_2, and HfB_2 are modified or otherwise affected by carbon is investigated experimentally at temperatures up to melting, in order to assess the effects of contact with carbon (graphite) in special devices or technological applications wherein such contact is required. The systems are prepared by direct synthesis and by the borocarbide process. The eutectic temperatures, eutectic compositions, and hypothetical state diagrams are determined for these systems. The formation of new solid phases and hence the solubility of carbon in the diborides are found to be negligible. The investigated mixtures are confirmed to be pseudobinary systems. Author

N65-32181*# National Aeronautics and Space Administration, Washington, D. C.
THE VAPOR PRESSURES OF ZINC OVER ALUMINUM-ZINC ALLOYS
A. Schneider and E. K. Stoll Aug. 1965 20 p refs Transl. into ENGLISH from Z. Elektrochem. (Weinheim), v. 47, 1941 p 527-535
(NASA-TT-F-8767) CFSTI: HC $1.00/MF $0.50 CSCL 07D

The vapor pressures of zinc over Al-Zn alloys of the entire concentration range were determined by means of a method that is based on the principle of the dew-point, and which has been described in detail. The measuring results were used for the calculation of the activities, of the free energy, and of the vaporization temperatures. The Al-Zn molten masses were shown to be regular concentrated mixtures. The results were discussed, with an eye toward the possible connections between the form of the activity curves and the liquidus lines of binary molten metal mixtures. Author

N65-32200# General Electric Co., Philadelphia, Pa. Missile and Space Div.
THE ATMOSPHERIC CHEMICAL KINETICS OF N_2O Scientific Report No. 2
M. H. Bortner 29 Apr. 1965 22 p refs
(Contract AF 19(628)-4153; DASA-WEB-07.010)
(AFCRL-65-367; AD-619254)

The chemical kinetics of N_2O has been considered in detail. The mechanisms of formation and consumption of N_2O and their total rates below 100 km have been calculated as well as our present knowledge of the parameters involved allows. N_2O is formed by one or more of the reactions $N_2 + O^- \rightarrow N_2O + e$, $N_2(A^3\Sigma) + O_2 \rightarrow N_2O + O$, and $N_2 + O \rightarrow N_2O + h\nu$. It is consummed by the photodissociation into $N^* + O$ and $N + NO^*$. The rates of these reactions are slow enough to permit the mixing of N_2O throughout this region of the atmosphere. Author

N65-32239# Raytheon Co., Waltham, Mass. Research Div.
GROWTH AND PROPERTIES OF II-VI COMPOUNDS Final Report, Oct. 1962-Jan. 1965
D. Warschauer and M. Lichtensteiger Wright-Patterson AFB, Ohio, ARL, May 1965 39 p refs
(Contract AF 33(657)-9809)
(ARL-65-99; AD-618303)

The preparation of powders of II-VI compounds of high purity was investigated. The group II metal starting material was purified by repeated distillation under argon. Purities of 99.99% were attained. Various methods of synthesis of the compounds were evaluated with regard to maintaining purity and additional purification. Hydrogen reduction of the chalcogenates was selected, resulting in powders with a total impurity content of less than 40 ppm. Attempts to grow single crystals were only partly successful due to the highly refractory nature of the compounds. Small single crystals of barium sulfide were obtained, however, they are heavily contaminated with tungsten. Author

N65-32261*# National Aeronautics and Space Administration, Washington, D. C.

QUENCHING AND CHANGES IN DURATION OF LUMINESCENCE IN THE SENSITIZED PHOSPHORESCENCE OF AROMATIC COMPOUNDS [TUSHENIYE I IZMENENIYE DLITEL'NOSTI SVECHNIYA PRI SENSIBILIZOVANNOY FOSFORESTSENTSII AROMATICHESKIKH SOYEDINENIY]

V. L. Yermolayev Aug. 1965 11 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 102, no. 5, 1955 p 925–928

(NASA-TT-F-8757) CFSTI: HC $1.00/MF $0.50 CSCL 07D

The mechanism of sensitized phosphorescence was investigated by studying the quenching of the luminescence of an energy donor by the acceptor and measuring the decay time for the luminescence of the components. By employing benzaldehyde + naphthalene, benzophenone + naphthalene, benzophenone + α-methyl naphthalene, carbazole + naphthalene, and other analogous systems, it was shown that the presence of an energy acceptor reduces the lifetime of a phosphorescence energy donor molecule. It was also observed that the decay time of the afterglow of carbazole decreases in the presence of an energy acceptor. When α-methyl naphthalene in a concentration of 4.6×10^{-1} mole/liter was added to the benzyl solution the decay time of the benzyl changed from 4.45×10^{-3} sec to 4.3×10^{-3} sec which was not beyond the limits of experimental errors while the decay time of benzophenone changed from 4.7×10^{-3} to 3.5×10^{-3} sec under the same conditions. E.E.B.

N65-32266*# National Aeronautics and Space Administration, Washington, D. C.

DESORPTION OF BARIUM OXIDE MOLECULES FROM TUNGSTEN IN A STRONG ELECTRIC FIELD [DESORPTSIYA MOLEKUL OKISU BARIYU Z VOL'FRAMU V SIL'NOMU YELEKTRICHNOMU POLI]

A. G. Naumovets' Jul. 1965 14 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 8, no. 1, 1963 p 65–71

(NASA-TT-F-9469) CFSTI: HC $1.00/MF $0.50 CSCL 07B

The field desorption of BaO molecules from tungsten was studied over a temperature range of 80–1200° K by means of Müller's field emission microscope. Müller's experiments for Ba on W were also repeated over the same temperature range for comparison. The dependence of the square root of the field strength upon the temperature at low coverages is presented. The theory of ion vaporization over Schottky barrier, when applied to the case of BaO and Ba on W, predicts the following: 1) The field desorption of BaO must occur as BaO^+ within the 80–400° K range and as BaO^{++} within the 500–1100° K range. 2) Barium must be field-desorbed from W in the form of singly-charged ions over the 80–300° K and 1000–1200° K regions, and as doubly-charged ions at 300–1000° K. Author

N65-32267*# National Aeronautics and Space Administration, Washington, D. C.

NEW DATA ON NONSTOICHIOMETRIC ALUMINA-ISOTHERMAL VARIATION OF THE ELECTRICAL CONDUCTIVITY AS A FUNCTION OF OXYGEN PRESSURE [DATE NOI IN LEGATURA CU ALUMINELE NESTOECHIOMETRICE, VARIATIA IZOTERMA A CONDUCTIBILITATII ELECTRICE CU PRESIUNEA DE OXIGEN]

L. Literat Aug. 1965 11 p refs Transl. into ENGLISH from Bul. Stiintific, Inst. Politeh. (Cluj), no. 7, 1964 p 87–93

(NASA-TT-F-9488) CFSTI: HC $1.00/MF $0.50 CSCL 07B

The electrical conductivity of nonstoichiometric alumina is investigated at constant temperature as a function of oxygen pressure. Experiments at 380° C reveal in alumina the presence of atomic Al. The log σ is found to be a function of the log P_{O_2} in alumina when Al^+, Al^{+2} ions, and metallic Al are present in the interstices. Author

N65-32285# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF VARIOUS TYPES OF ADHESION BONDS

N. A. Krotova, L. P. Morozova et al 6 Jul. 1965 18 p refs Transl. into ENGLISH from Kolloid Zh. (Moscow), v. 26, no. 2, 1964 p 207–214

(FTD-TT-65-327/1+2+4; AD-618060)

Several phenomena at the polymer-solid substrate interface have been investigated with the objective of elucidating the mechanism of adhesion. It has been established by IR spectroscopy that adhesion of polymers is largely due to chemical (donor-acceptor) interactions. The adhesion can therefore be controlled by rational selection of the functional groups of the adhesive and substrate on the basis of their donor-acceptor properties. The change in characteristics of a semiconductor on formation of adhesion bond between it and the polymer and the part played by the functional groups of the polymer, responsible for the degree of charge of the surface, have been determined. The effect of the functional groups of the polymer on the intensity of electron emission observed on breakdown of the adhesion bond has been investigated by a novel method. Author

N65-32304# Naval Research Lab., Washington, D. C.

CHEMONUCLEAR SYNTHESIS OF NITROGEN–FLUORINE COMPOUNDS

R. N. Hazlett 21 Apr. 1965 14 p refs

(NRL-6239; AD-615602) CFSTI: $0.50

Mixtures of nitrogen and fluorine containing uranium-235 as uranium hexafluoride have been exposed to the radiation field of a nuclear reactor. The fission fragments formed by reaction of ^{235}U with the thermal neutron component of the reactor radiation have caused the formation of nitrogen fluorides. Those identified were nitrogen trifluoride, cis-difluorodiazine, and trans-difluorodiazine. Nitrogen trifluoride is the major product, and the amount formed is dependent upon the total energy deposited. The other two products are in equilibrium with each other, and the amount formed decreases as the radiation intensity increases. The total G value for compound formation is less than 1 molecule per 100 electron volts. Author

N65-32312# California Univ., Berkeley. Lawrence Radiation Lab.

NUMERICAL EVALUATION OF CURRENT DISTRIBUTION IN ELECTRICAL SYSTEMS

R. N. Fleck (M.S. Thesis), D. N. Hanson, and C. W. Tobias Sep. 1964 79 p refs

(Contract W-7405-ENG-18)

(UCRL-11612)

A computer program has been written in Fortran language for the numerical solution of the Laplace equation with non-linear boundary conditions. The specific application is for the solution of the current flows and potential fields in a well stirred electro-chemical cell with or without polarization. Arbitrary geometries are handled. The program employs both doubling and overrelaxation to accelerate the convergence. A listing of the program is included. A new empirical method has been developed to determine the optimum overrelaxation factor and it appears to have specific applications for non-rectangular geometries and/or non-linear boundary conditions. A catalogue of analytical solutions for the Laplace equation has been prepared from information in the literature. Author

N65-32315# Denver Univ., Colo. Denver Research Inst.
A STUDY OF THE SYNTHESIS AND PROPERTIES OF TRANSITION-METAL HYDRYLS Final Summary Report
Charles B. Magee 15 Oct. 1964 36 p refs
(Contract AT(11-1)-1185)
(DRI-2189; EURAEC-1251)

There are single intermediate phases in the Li–Rh and Li–Ir systems. The stoichiometries of these phases are LiRh and LiIr. X-ray diffraction analyses show these phases to be hexagonal. Two eutectics in the LiRh binary system are indicated, one on either side of the intermediate phase LiRh. A tentative phase diagram for this system is presented. Hydryl compounds exist in both the Li–Rh–H and Li–Ir–H systems. Equilibrium hydrogen pressure measurements as a function of temperature and hydrogen concentration in the condensed phase indicate that when hydrogen is added to 4 to 1 molar ratio mixtures of Li and Rh the condensed material is a single phase at temperatures between 600° and 800° C and for all hydrogen concentrations to that corresponding to the stoichiometry $(LiH)_4RhH$. Experiments with mixtures of cobalt and LiH or Li indicate that cobalt forms hydryls and most likely an intermediate phase with lithium.
E.E.B.

N65-32319# Brussels Univ. (Belgium).
A STUDY OF SOME METAL OXIDATION PROBLEMS AND APPLICATION OF IMPEDANCE MEASUREMENT METHODS TO THE STUDY OF RESISTANCE TO CORROSION IN AN AQUEOUS MEDIUM Final Report No. 1, Part 2
[1964] 21 p refs Transl. into ENGLISH from FRENCH
(Contract EURATOM-081-62-5 RDB)
(EURAEC-1129, Pt. 2)

For platinum as for gold, the anodal process was found to be accompanied by an immediate and important growth of the electrode capacitance followed by a slow increase with time. This behavior is just the opposite of that shown by metals such as aluminum and zirconium for which the thickening of the oxide diminishes the value of the dynamic capacity. In the case of gold it appears that the increase of capacitance with time can be explained only by the formation of a surface compound endowed with good electronic conductivity and offering a porous structure. In the case of platinum it is difficult to provide positive proof of an oxide film. The fact that the capacity grows has led some authors to reject the theory of the formation of oxide in favor of the concept of chemisorbed oxygen. However, the data presented appears to favor the formation of oxide. Coulometric measurements confirm that the variation of the differential capacitance observed during the anodal oxidation of the gold is accompanied by a growth of the quantity of oxygen formed.
E.E.B.

N65-32320# California Inst. of Tech., Pasadena. Div. of Geological Sciences.
O^{18}/O^{16} RATIOS OF SOME CHRONDRITIC METEORITES AND TERRESTRIAL ULTRAMAFIC ROCKS
J. H. Reuter, S. Epstein, and H. P. Taylor, Jr. [1964] 12 p refs *Its* Publ. Contrib. 1287
(Contract AT(04-3)-427; Grant NSF G-23992)
(CONF-759-2)

Oxygen isotopic analyses were made on the silicate portions of 27 chrondrites, 2 pallasites and 10 terrestrial ultramafic rocks using a fluorine extraction procedure. The presence of sulphides, free iron, iron oxides (formed by weathering of the meteorites), and olivine contributes difficulties to the extraction of the oxygen. Consequently, before fluorinations were done the samples were subjected to several pretreatments. Heating in vacuum and in an atmosphere of hydrogen removed the oxygen added to the meteorites during weathering. Dry chlorination at 350° C removed the iron and sulphide phases. Fusion of the samples with known amounts of quartz of known O^{18}/O^{16} ratio converted the olivine to a pyroxene glass and permitted attainment of 100 per cent yields in the extraction of the oxygen. The total isotopic variation in the analyzed chondrites is only 1.2 per mil. The pallasite olivines are about 2 per mil lower in O^{18}/O^{16} than the average chondrite. It is possible to detect some grouping within the 1.2 per mil range in the δ-values of the chondrites. The δ-values for terrestrial dunites and olivines are within the range of δ-values reported by previous workers and are isotopically similar to the olivine–hypersthene chondrites.
Author

N65-32328# Stanford Research Inst., Menlo Park, Calif.
SORPTION OF GASES ON METAL SURFACES IN ULTRA-HIGH VACUUM Quarterly Progress Report No. 8, 15 May-15 Aug. 1964
B. Bergsnov-Hansen, A. P. Brady, N. Endow, and R. A. Pasternak 31 Aug. 1964 11 p
(Contract AT(04-3)-425)
(SRIA-128)

A quadrupole mass spectrometer was used to study the interactions of hydrogen and deuterium with the walls of the system. The observed values for the emission current versus the ion current at constant hydrogen pressure are tabulated, and the ion currents for hydrogen and for CO, the main contaminant, are plotted as a function of hydrogen pressure. Deuterium data are also graphically depicted, and show linearity between pressure and ion current. Results indicate that a low contamination level can be maintained even at high hydrogen pressures, if the system is well baked, low temperature coated electron emitters are used, the feed gas is of high purity, and high flow rates are employed. In theoretical considerations of hydrogen–deuterium exchange reaction on a molybdenum filament, a mechanism for the exchange reaction is formulated. Tabular data on the exchange rate as a function of time, and on the exchange reaction are also presented. A magnetic deflection type mass spectrometer is discussed, and the spectra obtained at identical amplification are illustrated.
M.G.J.

N65-32336# European Atomic Energy Community, Brussels (Belgium).
OSCILLOGRAPHIC POLAROGRAPHY IN MOLTEN NITRATES. I: THE VALIDITY OF THE RANDLES-SEVCIK EQUATION
M. Francini and Silvana Martini 1964 40 p refs Presented at the 19th Intern. Cong. of Pure and Appl. Chem., London, 10–17 Jul. 1963
(EUR-1908.e; CONF-151-6)

Validity of the Randles–Sevcik equation as well as that of equations derived by Matsuda in molten nitrate systems is demonstrated. Diffusion coefficients can be calculated from oscillopolarographic data in the case of fully reversible equations. It was concluded that oscillopolarography is more sensitive than polarography in detecting degree of reversibility of electrode reactions. The order of reversibility of the investigated ions is Ti > Cd > Pb > Zn > Ni. Diffusion coefficients are given for the various ions at different concentrations and temperatures between 150° and 200° C; and logarithms of diffusion coefficients versus reciprocal absolute temperature are plotted. Peak potential is found to be related to half-wave potential but independent of concentration and of voltage change rate.
M.W.H.

N65-32340# Stanford Research Inst., Menlo Park, Calif.
THE DETERMINATION OF WATER IN SOLID PROPELLANTS Final Technical Report, Jun.–Oct. 1964

R. F. Muraca Oct. 1964 22 p refs
(Contract AT(04-3)-115)
(UCRL-13136)

Two procedures are described for determining the water content of solid propellants containing nitrato ester oxidants. One procedure has been specifically designed for use by skilled laboratory technicians; it is predicated on the use of an efficient titration system for the Karl Fischer reagent. Water accumulation in the titration vessel from the atmosphere or other sources is minimized by the use of specially-dried helium. As a result, the water content of solid propellants requiring times greater than one hour for dispersion in solvents can be determined accurately. The other procedure embodies the use of a specially-constructed manometric vessel and is based on the measurement of hydrogen pressure resulting from the reaction of calcium hydride with the water content of a solid propellant sample. Both methods are applicable for the determination of water in solid propellants containing from 0.10 to 0.01 per cent water. The role of the solvent in both determinations is discussed. Author

N65-32372# Oak Ridge National Lab., Tenn.
CHEMISTRY DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING MAY 20, 1965
Sep. 1965 177 p refs
(Contract W-7405-ENG-26)
(ORNL-3832) CFSTI: $5.00

Progress is reported on a wide spectrum of research in the following areas: *Nuclear Chemistry*; *Nuclear and Inorganic Chemistry of Special Elements*; *Isotope Chemistry*; *Radiation Chemistry*; *Organic Chemistry*; *Chemistry of Aqueous Systems*; *Electrochemical Kinetics and its Application to Corrosion*; *Nonaqueous Systems at High Temperatures*; and *Chemical Physics*. Also, publications, papers presented at scientific and technical meetings, and lectures are included. E.E.B.

N65-32378# International Union of Pure and Applied Chemistry, Basle (Switzerland). Sub-Commission on Condensed States.
BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF MATERIALS IN THE CONDENSED STATE, APRIL, MAY, JUNE 1965, VOLUME 1965, NUMBER 2
J. J. Diamond, ed. (Natl. Bur. of Std., Washington) [1965] 66 p refs

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N65-31264 Communication Satellite Corp., Washington, D. C.
THE GLOBAL COMMERCIAL COMMUNICATIONS SATELLITE SYSTEM—AN UP-TO-DATE SUMMARY AND REVIEW
Edwin J. Istvan *In* Arg. Natl. Comm. on Space Res. Interam. Symp. on Space Res., Proc., Vol. 1 1965 6 p (See N65-31263 20-30)

The current status of the program for the global commercial communications satellite system is reviewed. The establishment of international arrangements for the use of the satellite, the technical feasibility and economic viability of establishing and operating the system, the technical timetable for full global communications coverage, international financing and ownership of the satellite and earth stations, and provisions for satellite use by non-investors are discussed. R.N.A.

N65-31272* Smithsonian Astrophysical Observatory, Cambridge, Mass.
BAKER-NUNN TRACKING OF THE AIR DENSITY EXPLORER BALLOON AND THE INJUN EXPLORER SPACECRAFT
Ellis A. Monash *In its* Res. in Space Sci. Some Results at Smithsonian Observing Sta. 17 May 1965 p 24–36 (See N65-31268 20-13) CFSTI: HC $2.00/MF $0.50

Observational methods were used to confirm separation; inflation of the balloon; number of objects placed into orbit; apparent brightness of each piece in orbit; and an identification and position of each piece. Photographs of the separation are presented, and the physical characteristics and orbital elements are tabulated. C.T.C.

N65-31278 Joint Publications Research Service, Washington, D. C.
USE OF PHASE TECHNIQUES TO STUDY THE POLARIZATION PHENOMENA OF RADIO WAVES REFLECTED FROM METEOR TRAILS
V. V. Sidorov, A. F. Pavlov, and R. Yu. Fakhrutdinov *In its* Izv. VUZov: Radiofiz., Vol. VIII, No. 2, 1965 10 Aug. 1965 p 23–35 refs (See N65-31275 20-23) CFSTI: $6.00

Results are presented for an investigation of polarization phenomena of radio waves reflected from meteor trails using the direct phase method. A method of indication of polarization phenomena in observations of meteor trail drift is proposed. A marked increase in resonance time on transition to denser trails tends to contradict the theory of "metallic" resonance. If the earth's magnetic field is the cause of the anisotropy in trails giving long reflections, the structure of the trail must be looser than that realized in the case of purely ambipolar diffusion in the meteor trail. Author

N65-31279 Joint Publications Research Service, Washington, D. C.
REDUCTION FOR A FINITE PASSBAND RADIOINTERFEROMETER
A. Balklav *In its* Izv. VUZov: Radiofiz., Vol. VIII, No. 2, 1965 10 Aug. 1965 p 36–43 refs (See N65-31275 20-23) CFSTI: $6.00

The problem of restoring the true radio brightness distribution is investigated for a cosmic radio source with allowance for a finite radiointerferometer passband for both ordinary and "spatial" frequencies. Author

N65-31281 Joint Publications Research Service, Washington, D. C.
OPERATOR METHOD OF DESCRIBING WAVE BEAMS IN COMBINED QUASI-OPTICAL SYSTEMS
V. I. Talanov *In its* Izv. VUZov: Radiofiz., Vol. VIII, No. 2, 1965 10 Aug. 1965 p 56–69 refs (See N65-31275 20-23) CFSTI: $6.00

The passage of a wave beam through a system of amplitude-phase converters forming a quasi-optical waveguide or resonator is described by a series of linear operators corresponding to the individual elements of the system. The author

gives the principal relations between these operators permitting the realization of equivalent transformations of quasi-optical systems. The use of the operator method for describing wave beams is illustrated by means of a series of examples. Author

N65-31283 Joint Publications Research Service, Washington, D. C.
INTERACTION OF ELECTROMAGNETIC SHOCK WAVES IN NONLINEAR TRANSMISSION LINES
L. A. Ostrovskiy *In its* Izv. VUZov: Radiofiz., Vol. VIII, No. 2, 1965 10 Aug. 1965 p 87–95 refs (See N65-31275 20-23) CFSTI: $6.00

The problem of the interaction of shock waves in a line with an arbitrary quasi-static nonlinear characteristic is considered. The question of shock wave transmission across the interface between two lines is also discussed. Author

N65-31284 Joint Publications Research Service, Washington, D. C.
ON THE THEORY OF PROPAGATION OF STATIONARY WAVES OF FINITE AMPLITUDE IN FERRITES
Yu. F. Filippov *In its* Izv. VUZov: Radiofiz., Vol. VIII, No. 2, 1965 10 Aug. 1965 p 96–106 refs (See N65-31275 20-23) CFSTI: $6.00

The presence of dispersion prevents the distortion of the front of a wave propagated in a ferrite due to nonlinear effects. In this case the frequency of the stationary wave depends not only on the properties of the medium and the angle between the magnetic field and the direction of propagation of the wave, but also on the wave amplitude. The variation in the constant component of the intensity of magnetization of the ferrite is observed. Stationary pulses can be propagated in the ferrite for a definite relation between its parameters and the amplitude. Author

N65-31296 Joint Publications Research Service, Washington, D. C.
THE THEORY OF ANTENNA SYNTHESIS
V. N. Dymskiy *In its* Izv. VUZov: Radiofiz., Vol. VIII, No. 2, 1965 10 Aug. 1965 p 236–242 refs (See N65-31275 20-23) CFSTI: $6.00

Any directivity pattern realized by sources distributed within an assigned finite region of arbitrary geometric configuration may be reproduced by a current represented in this region in the form of an integral of the transverse plane waves. A linear self-adjoint operator UV is used for calculating the space division of the sources, and the introduction of the operator V permits the description of a general method for solving the synthesis problem of an antenna of assigned configuration with a minimum current norm. Operator V may also be used for approximate qualitative solutions when the geometric configuration of current distribution is not initially given. The method described may be of value for antenna devices with a small reactivity. M.W.R.

N65-31489# Rome Air Development Center, Griffiss AFB, N. Y. Space Surveillance and Instrumentation Branch.
A MULTICAMERA SOLUTION TO THE PROBLEM OF ANTENNA SURFACE DEVIATION AND SUBREFLECTOR ORIENTATION MEASUREMENTS Final Report
Dean C. Merchant and Charles A. Ballou Jun. 1965 47 p refs
(RADC-TR-65-212; AD-618205)

This report describes an improved technique for determining surface deviations of precision radar antennas. Data reduction procedures for determining antenna surface shape and subreflector orientation of a 20 meter radar antenna by means of terrestrial photogrammetry are presented. Raw data in the form of photo coordinates together with assumed camera and antenna orientations are processed in a least squares method analysis to obtain antenna surface deviations and subreflector orientation elements. Additional processed data includes space coordinates and standard errors for all points. Accuracy based on a test case is concluded to be of the order of ±0.3 millimeter for a twenty meter parabolic antenna. Author

N65-31510# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
ELECTROMAGNETIC SCATTERING FROM AN INFINITE CIRCULAR CYLINDER AT OBLIQUE INCIDENCE
William A. Farone and Charles W. Querfeld Apr. 1965 18 p refs
(ERDA-287; AD-462001)

The solution of the problem of electromagnetic scattering from an infinite circular cylinder with an obliquely incident plane wave is rederived and is recast into a form suitable for machine computation. The formalism employed is consistent with major references and is developed for use in the extension of the theory to the oblique inhomogeneous cylinder case. Author

N65-31512# Naval Research Lab., Washington, D. C.
RECEPTION VIA THE SYNCOM II COMMUNICATION SATELLITE USING AN 8-FOOT PARABOLIC ANTENNA
W. E. Leavitt and J. P. Spraitz 17 May 1965 19 p refs
(NRL-MEMO-1617; AD-617557)

Signals transmitted by the U.S. Army Satellite Communication Agency's (USASCA's) Camp Roberts terminal via Earth satellite SYNCOM II were received at the Naval Research Laboratory (NRL) using an eight-foot diameter parabolic antenna feeding into a parametric amplifier. The antenna system configuration provided performance capability equivalent to a 5.7-foot diameter parabolic antenna with 237° K (Kelvin) noise temperature. Phase lock frequency modulation (fm) detection circuitry was used for demodulation of the received signal. Voice reproduction was slightly distorted when the satellite was operating in the simplex mode with the Camp Roberts transmitter adjusted for 200 watts input to its 60-foot antenna (radiation efficiency—55%). Received signal strength was found to be in agreement with predicted values. Author

N65-31525# Northwestern Univ., Evanston, Ill. Technological Inst.
ON PROBABILISTIC GRAPHS AND SOME APPLICATIONS Technical Report No. 13
Howard Frank Jun. 1965 96 p refs
(Grants AF-AFOSR-98-63; DA-ARO(D)-31-124-G223)
(AROD-3298-17)

Several physical systems which have a natural association with the linear graph are examined. The linear graph model of the deterministic systems, i.e., communication networks and sequential machines, proves inadequate in representing these systems when they are operating in real environments. The problem of random flow in communication networks is solved for the cases where flow distributions are either known or unknown. In the latter case, it is shown that a simple, statistical, testing procedure may be applied. The problem of improving communication networks whose maximum flow rate probability is too small is discussed. A flow problem is also considered in which error in the message routing is possible. The state behavior of a deterministic sequential machine with error in its state transition is analyzed, and reliability indices are defined as a measure of the reliability. R.R.D.

N65-31527# ADCOM, Inc., Cambridge, Mass.
ANALYSES OF PRECISION OMNIRANGE SYSTEMS **Final Engineering Report**
Elie J. Baghdady, G. Maurer, H. C. Fritz, A. C. Marshall, and S. A. Meer Jan. 1965 202 p refs
(Contract ARDS-589)
(Rept. 65-23)

In the earlier chapters (II-IV) some aspects of the simulated doppler VOR are treated theoretically. The results of this analysis show that the basic doppler VOR system has a potentially high precision and that the errors in the current doppler VOR system can be reduced by appropriate modifications to the receiver and the station. The remaining chapters show what can be done to improve the DVOR receiver and the station. Flight test data covering the various techniques for improvement are given. The technical feasibility of the general Precision Doppler VOR concept is demonstrated by the given data. The improvements can be combined into a proposed compatible Precision Doppler VOR System which is discussed in Chapter VIII. The merits of a PDVOR system are discussed in Chapter IX. Author

N65-31591# General Motors Corp., Santa Barbara, Calif. Aerospace Operations Dept.
RADAR SCATTERING FROM WAKES
R. I. Primich, P. E. Robillard, L. Wilson, R. A. Hayami, and S. Zivanovic Mar. 1965 48 p refs
(Contract DA-01-021-AMC-11359(Z); ARPA Order 347; Proj. Defender)
(TR65-01E; AD-463827)

Measurements of basic value to the determination of the radar scattering from wakes behind vehicles reentering the earth's atmosphere are currently being made in a hypersonic range facility. These are supported by analytical studies intended to aid in the design of experiments and in the interpretation of data. Transition from laminar to turbulent flow in the wakes behind spheres and slender cones has been observed with both schlieren and radar devices. Comparative data on the differences in transition distance as obtained from the two instruments are presented and discussed. The backscatter radar signal from the turbulent wake behind a nonablating sphere shows a prouounced periodicity. The latter has been interpreted as wake velocity and compares favorably with theory. In the case of slender cones the signal is more complex and the extraction of wake velocity has not been possible to date. The complexity is believed to be due to the existence of pronounced laminar instabilities and large scale structure preceding the breakup into fully developed turbulence. Author

N65-31600# Army Missile Command, Huntsville, Ala. Electro Optical Branch.
AN AUTOMATIC DIGITAL OPTICAL TRACKER
Roy B. York 30 Oct. 1964 26 p refs
(RE-TR-64-13; AD-454509)

An Automatic Digital Optical Tracker capable of tracking 72 pseudo circular targets is described with emphasis on the design criteria. The tracker extracts multitarget information from the video signal of a television type sensor. In addition to tracking, it measures the video pulse amplitude and width for each target. Since the targets encountered for processing have a random spatial distribution, particular attention is paid to resolution requirements and buffer storage size to insure a high probability of success in gathering pertinent data. This tracker possesses capabilities in excess of those imposed on it by system parameters. Consequently ADOT can operate with sensors which dictate more stringent tracking accuracies. This equipment, once placed in the fieid, will simplify data reduction since computer assistance may be utilized for reducing ADOT output data. Author

N65-31604# Aerospace Corp., El Segundo, Calif. Plasma Research Lab.
RADIATION PATTERNS FROM A SLOTTED CYLINDER SURROUNDED BY A PLASMA SHEATH
T. M. Smith 14 Sep. 1964 27 p refs
(Contract AF 04(695)-269)
(SSD-TDR-64-172; TDR-269(4280-10)-6; AD-450118)

A slotted cylinder microwave antenna, surrounded by a thin plasma sheath that is located an arbitrary separation distance from the cylinder, is examined both theoretically and experimentally. Results are presented to demonstrate the effects of electron density, collision frequency, and separation distance on the antenna patterns. A grid of wires is used to simulate the thin plasma sheath in the experimental investigation. Experimental results obtained in this way verify the agreement between theory and experiment. Author

N65-31613# Ohio State Univ. Research Foundation, Columbus. Antenna Lab.
TECHNIQUES FOR CALCULATING AND IMPROVING THE PERFORMANCE OF MULTILAYER RADOMES
Walter Herbert Heffner, Jr. 31 Dec. 1964 83 p refs
(Contract AF 33(615)-1081)
(Rept.-1751-9; AD-464892)

A study is made of the problems arising in the design of a radome for use at millimeter wavelengths. If a homogeneous radome is employed, it must be several wavelengths thick to provide adequate structural strength. At X-band and lower frequencies, the performance of a multilayer radome sandwich is shown to be improved considerably by including thin ferrite layers. A quadratic interpolation technique is described for speeding up the computer optimization of the dielectric constants and thicknesses of the layers in a sandwich. Computer programs and typical results are included to illustrate this approach to the optimization of the core thickness of a three-layer sandwich. It is shown that the "B" sandwich with electrically thick skins and core has useful characteristics at millimeter wavelengths. Its bandwidth, transmission efficiency, and range of incidence angles are superior to those of the "A" sandwich and the homogeneous radome. Author

N65-31618# Gottingen Univ. (West Germany). Physikalisches Institut.
ABSORPTION AND TRANSMISSION OF ELECTROMAGNETIC WAVES. PHASE C: COMBINATION OF MAGNETIC LAYER- AND GRAPHITE FOIL ABSORBERS **Final Scientific Report**
Norbert Roy 31 Dec. 1964 31 p refs
(Contract AF 61(052)-667)
(AD-466934)

One-layer absorbers effective on the magnetic field are computed and tested in the experiment. The importance of some conditions imposed on the material data ϵ and μ for a maximum bandwidth is discussed. Ratios of the band limits of about 10 for the frequency range of 18 to 180 megacycles are achieved. Greater bandwidths are possible by subdivision of the homogeneous layer into two layers in series made out of different ferrites, Mn-Zn and Ni-Zn ferrites for example. The first layer of these two-layer absorbers is designed to be most effective for the high frequencies whereas the layer in front of the short circuit determines the lower cut-off frequency. With a total thickness of 2.7 centimeters a ratio of the cut-off frequencies as high as 50 was obtained within the frequency limits at 3.9 and 200 megacycles resp. Author

N65-31619# Gottingen Univ. (West Germany). Inst. of Physics.
ABSORPTION AND TRANSMISSION OF ELECTROMAGNETIC WAVES. PHASE E: HOLLOW WAVEGUIDES WITH COMPLEX INPEDANCES OF THE WALLS

D. Eisfeld 1 Mar. 1965 54 p refs
(Contract AF 61(052)-667)
(AD-466935)

A novel measuring method is described suitable for recording reflection coefficients or after slight alterations transmission coefficients in magnitude and phase as function of frequency in the microwave range. The measuring and a reference signal are marked by different frequency shifting. After initially having been treated in a single channel both signals are equaled in frequency and then compared. A hollow waveguide which guides TEM-waves at a certain frequency is investigated by aid of this device. It consists in a rectangular duct where two opposite walls are metallic whereas the remaining two are composed of closely stacked resonators. The resonators are tiny waveguides filled with a dielectric of high ϵ and are short-circuited at one end. At a certain frequency their input impedance becomes very great on account of a $\lambda/4$-resonance. Thus the whole resonator wall gets a great surface impedance necessary for guiding TEM-waves. The so-called "TEM-waveguide" is in a narrow frequency band a pendant of the Kundt's tube in acoustics, where it is used to measure reflection coefficients at normal wave incidence. The TEM-waveguide has a strong dispersion. As there is a lower and a higher cut-off frequency it can be used as reflection filter of relatively wide transmission range. Author

N65-31626# Sperry Gyroscope Co., Great Neck, N. Y. Radiation Div.
TRANSIENT BEHAVIOR OF LARGE ARRAYS Final Report, 1 Mar.–23 Nov. 1964
G. F. Ross, L. Susman, and J. Hanley Griffiss AFB, N. Y., RADC, Jun. 1965 244 p refs
(Contract AF 30(602)-3348)
(EB-5287-0500-3; RADC-TR-64-581; AD-618701)

Results in a theoretical and experimental investigation of the transient behavior of microwave components used in feed networks of large antenna array systems are reported. In particular, the transient behavior of the cylindrical and spherical Luneberg lenses was evaluated. The approximate impulse response to a probe and horn in the far field was found. Transient response of various UHF, L band, and X band devices was determined experimentally. Step response of UHF and L band components was studied using a real time reflectometer. The modulated step resonance of various components was found by using newly developed techniques for the generation and display of synchronized step modulated waveforms. J.M.D.

N65-31627# Scientific-Atlanta, Inc., Atlanta, Ga.
PRECISION ANTENNA PATTERN RECORDING TECHNIQUES, PHASE II Third Quarterly Interim Report
Jack B. Chastain Griffiss AFB, N. Y., RADC, June 1965 27 p refs
(Contract AF 30(602)-3425)
(RADC-TR-65-85; AD-618702)

Precision antenna pattern recording techniques are presented. This contract is for continuation of work performed under Contract AF 30(602)-2737, in which a study and investigation was made to prove the feasibility of precision amplitude- and angle-measuring devices, combined with sophisticated recording and display techniques, for antenna pattern measurements. The current program includes development of a stabilized transmitter, a precision, high data rate receiver and associated equipment, and continuation of the theoretical investigation reported under the previous contract. The transmitter and receiving equipment will be installed and tested at the USAF Antenna Proving Range at Newport, New York. Author

N65-31629# Rome Air Development Center, Griffiss AFB, N. Y. Communications Research Branch.
TUNNEL DIODE OSCILLATOR ANTENNA Final Report
John J. Patti Jun. 1965 35 p refs
(RADC-TR-65-218; AD-618714)

The purpose of this work was to develop a suitable signal source which could be hung from a balloon and used as a boresight source for an S-band receiving system. Such a source was developed, as indicated by the theory and by the experimental circuit constructed. The test circuit exhibited marginal frequency stability. It is shown in the theory that a circuit consisting of an antenna of compact design of the same type, when connected to an oscillator which is packaged in a temperature-controlled environment, would show an improvement in frequency stability. It is also shown that a further improvement in stability could be achieved by increasing the slope of the function, $\gamma_T = |f_\gamma(j\omega)|$ in the neighborhood $\gamma_T = 0$. A simple modification on the present circuit would increase the slope of γ_T. With these modifications taken into consideration, a more stable stripline tunnel diode oscillator-antenna can be constructed. Author

N65-31641# Sylvania Electric Products, Inc., Waltham, Mass. Applied Research Lab.
INFINITE CYLINDRICAL ANTENNA IMMERSED IN A WARM PLASMA Scientific Report No. 9
S. R. Seshadri 1 Jun. 1965 29 p refs
(Contract AF 19(628)-2410)
(AFCRL-65-408; AD-618519)

The radiation characteristics of an infinite cylindrical antenna insulated from the surrounding warm plasma by a concentric cylindrical sheath of free-space are investigated for the case in which it is excited by means of a Delta function voltage source. The uncoupled electromagnetic (EM) and the plasma (P) space waves are excited. The radiation pattern and the normalized radiation resistance of the antenna for the EM and the P modes are studied as a function of (1) the frequency, (2) the radius of the antenna, and (3) the thickness of the insulation. The effect of the insulating ion sheath is found to be of some significance only for the case of the P mode. Author

N65-31643# Air Force Cambridge Research Labs., Bedford, Mass. Data Sciences Lab.
OPTIMUM BINARY FSK FOR TRANSMITTED REFERENCE SYSTEMS OVER RAYLEIGH FADING CHANNELS
Neil J. Bershad Jun. 1965 29 p refs *Its* Physical Sci. Res. Papers No. 113
(AFCRL-65-441; AD-618564)

The randomly time-varying channel studied is that of a Rayleigh fading medium with independently fading mark and space channels whose fading is fixed over one band interval but is independent from band to band. The transmission system is a modified frequency shift keying (FSK) system such that during a portion of a band interval the mark and space frequencies are always transmitted so as to act as reference signals. For the above system, the following characteristics have been established: (a) Optimum receiver configuration, (b) Optimum ratio α of information energy to total signal energy as a function of total available signal-to-noise ratio for a single fading channel. (c) Asymptotic optimum α for an M-diversity channel. (d) Error probabilities for (b) and asymptotic error probabilities for (c) for α_{opt} as a function of total signal-to-noise ratio. The asymptotic results show that by using reference techniques the order of diversity is effectively doubled. Author

N65-31658 Joint Publications Research Service, Washington, D. C.
THE USE OF STORAGE CIRCUITS IN REMOTE CONTROL EQUIPMENT
Yu. V. Avetov and B. Ya. Sovetov *In its* Izv. VUZov: Instr. Building, Vol. VIII, No. 3, 1965 p 65–72 refs (See N65-31650 20-14) CFSTI: $5.00

This paper considers the conditions under which it is possible to ensure normal operation of a remote control system with a given intensity of pulse interference. An analysis is made of duplication with storage, particularly with codewise integration of the signal. Author

N65-31680# Holman (John F.) and Co., Inc., Washington, D. C.

A PHOTOELECTRONIC TRACKING DEVICE [FOTOELEKTRONNOYE SLEDYASHCHEYE USTROYSTVO]

G. P. Katys and Yu. V. Strel'nikov Fort Belvoir, Va., Army Engr. Res. and Develop. Labs., Jun. 1965 8 p Transl. into ENGLISH from Byul. Izobret. i Tovarnykh Znakov (USSR), no. 5, 26 Nov. 1964

(Contract DA-44-009-AMC-930(T))

(ERDL-T-1786-65; AD-617422)

A photoelectronic tracking device is proposed which does not use rotating pairs and in which a dissector tube serves as a sensitive element. In the absence of rotating mechanical elements, modulation is achieved by placing a round diaphragm in front of the dissector anode, in concentric relation to the axis of the projecting optical system and dissector. The electronic image of the tracked object can be seen moving in a circle within the plane of this diaphragm under the effect of the rotating magnetic field. The latter is produced by a stabilized source of alternating current which supplies two pairs of coils in the dissector transfer section with sinusoidal voltages which are of the same frequency but 90° out of phase in relation to each other. Time-voltage diagrams and representations of the various units of the device are shown. J.M.D.

N65-31687# Rome Air Development Center, Griffiss AFB, N.Y.

RADC TRINIDAD-ROME SATELLITE COMMUNICATION LINK Final Report

Rodney C. Pratt Jun. 1965 47 p refs

(RADC-TR-65-217; AD-466002)

This report describes the facilities at Rome and Trinidad which are used to perform communication experiments using the Echo type satellites. These facilities have undergone many modifications over the past five years and this report describes the facility as it presently exists. The Rome and Trinidad facilities provide a duplex communication link when used with passive satellites. The communication for this link is accomplished at S band while tracking at Trinidad is dependent upon a 427 mc radar set. There have been some unique developments in providing this capability with work continuing on a high power dual frequency feed. The Trinidad facility will be closed down by 30 June 1965 but the Floyd facility will be retained for future work. Author

N65-31810# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

A COMPARISON OF THE THRESHOLD PERFORMANCE OF THE FREQUENCY DEMODULATOR USING FEEDBACK AND THE PHASE LOCKED LOOP

Donald L. Schilling and Joseph Billig 28 Feb. 1964 30 p refs

(Grant NSF GP-2059)

(PIBMRI-1207-64)

This paper presents a simplified approach to the problem of threshold extension by the use of frequency demodulators with feedback, and phase locked loops. The response of these devices to an FM signal is obtained by extending Rices results for the FM discriminator. Using these results the authors replace each device by their linear equivalent circuit, and add one dependent noise source (the noise depends on the input signal-to-noise-ratio). The result is an easy way to analyze equivalent circuit for each device, and a simple equation describing the output signal-to-noise-ratio in terms of the input signal-to-noise-ratio and the system parameters. Experimental results are then presented which verify the theory. Author

N65-31829# Hughes Aircraft Co., Culver City, Calif. Aerospace Group.

[BROADBAND LONG-PULSE AMPLIFICATION, HIGH ENERGY AMPLIFIER STUDIES, AND MACH-ZEHNDER INTERFEROMETRY] Status Report No. 6, 15 Nov.–14 Dec. 1964

[1964] 23 p

(Contract AF 33(615)-1648)

(AD-463560)

Experimental and theoretical studies on broadband long-pulse amplification show that the steady state power gain best describes the amplification; the time development of this gain and the dependence on input signal flux and amplifier pump intensity are discussed in light of experimental data. An analytical model of the amplification of oscillator long pulse inputs over a range of conditions that includes narrowband signals as well as depumping by superfluorescence and internal modes is discussed. Measurements of the gain of 1/2 × 8 inch Nd:glass laser rods are given. Preliminary interferometric studies of optical path changes in the 1/2-inch diameter pumped rods indicate a possible connection between the gain and the rate of optical path changes during pumping. J.M.D.

N65-31830# General Applied Science Labs., Inc., Westbury, N. Y.

SCATTERING CROSS SECTIONS OF UNDERDENSE TURBULENT WAKES

F. Lane and W. Daskin 31 Dec. 1964 54 p refs

(Contract NOw-63-0637-c FBM)

(TR-463; AD-461648)

The assumptions used in underdense turbulent scattering are summarized. Typical results for underdense scattering from the turbulent wakes generated by several bodies are shown for a variety of assumed electron density fluctuation parameters. The results are characteristic of those which have been generated during the past year by combining non-equilibrium wake programs with scattering calculations. Author

N65-31854# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.

ANALYSIS OF SATELLITE TIME DATA

W. H. Guier Jan. 1964 26 p

(Contract NOw-62-0604-c)

(TG-547; AD-464355)

Methods used in the analysis and processing of information from satellites instrumented to supply time- and doppler-data are discussed. Presented are basic equations that connect the satellite transmitter frequency, the station's satellite time data, and the times that the satellites transmitted time markers. Techniques used to differentiate between doppler and time data points, and to reduce experimental time data to experimental times, are also discussed. Proposed is a simplified equation for predicting the times that satellite time markers are transmitted for station alert purposes. S.C.W.

N65-31869# Army Electronics Labs., Fort Monmouth, N. J. Electron Tubes Div.

COUPLED-MODE ANALYSIS OF SPACE-CHARGE-WAVE PROPAGATION IN ACCELERATED ELECTRON BEAMS

Bruno Zotter Apr. 1965 16 p refs

(ECOM-2580; AD-618385)

A coupled-mode analysis of signal and noise propagation on accelerated beams is discussed for two particular potential variations. The first case assumes a d-c potential achievable

only by the use of grids. A predicted noise reduction scheme using insertion of additional power into the fast space-charge-wave is shown to be rather limited. The second case discussed is the space-charge-limited diode region, and it is demonstrated that it does not show any noise reduction at all under the assumptions of the coupled-mode theory. Author

N65-31926# Weapons Research Establishment (Australia).
ON THE LINEAR DETECTION OF TWO AMPLITUDE MODULATED SIGNALS AND NOISE
J. S. Allison Jun. 1965 45 p refs
(WRE-SAD-39)

The classical theory dealing with the passage of one signal and noise through a linear detector is extended to include the case when the input consists of two amplitude modulated signals and (possibly) amplitude modulated noise, all of which have been passed through a narrowband filter. New methods are advanced for approximating the modulations terms and the coefficients appearing in the expansion representing the detector output. Also, an expression is derived for representing the output of a narrowband filter when the input is amplitude modulated noise. Author

N65-31932# Rome Air Development Center, Griffiss AFB, N. Y. Communications Research Branch.
CYBEC—A GENERAL PURPOSE BURST ERROR CORRECTOR
Walter R. Richard May 1965 51 p refs
(RADC-TR-65-158; AD-618686)

A general purpose error correction device has been constructed for use in digital communications evaluations. It uses cyclic burst error correction coding techniques. The device is designed and constructed to allow easy changing of the cyclic code to be used. The coder and decoder are easily programmed by means of a series of plugs and switches to use any burst error correcting code with a total block length of 63 bits or less, and with 19 or less check bits per block of data. The ratio of redundancy to information is easily varied. These coding constraints will allow correcting error bursts of up to nine bits in length. This report describes the construction details of the equipment in a form easily understood by an engineer with little background in coding theory. The report also presents a list of 22 codes which are easily programmed into the equipment. Author

N65-31938# General Applied Science Labs., Inc., Westbury, N. Y.
FREQUENCY EFFECTS IN THE SCATTERING OF MONOCHROMATIC PLANE-WAVE ELECTROMAGNETIC RADIATION BY TEMPORALLY AND SPATIALLY RANDOM DILUTE DISTRIBUTIONS OF ELECTRONS
Frank Lane and Thomas Flack 16 Dec. 1964 126 p refs
(Contract NOsp-64190-c(FBM))
(TR-470; AD-461649)

Scattering of electromagnetic radiation from turbulent ionized regions is studied, with particular emphasis on the scattered-signal frequency content available to a frequency-sensitive radar. In particular, frequency analysis of the scattered signal arising from plane-wave monochromatic illumination was developed for a series of electron density models which approximate the form and behavior of the nonsteady random electron distribution in a turbulent hypervelocity missile wake. It was found that the support of the power spectral density of the scattered signal can be described in detail without specifying the actual distribution of power over the support domain. Also, when allowance is made for a spatial autocorrelation pattern convecting with a radially nonuniform mean flow, the scattered signal frequency content can be determined accurately, and the general shape of the power distribution can be predicted for the pertinent frequency domain. J.M.D.

N65-31943# Michigan State Univ., East Lansing. Div. of Engineering Research.
BACKSCATTERING OF A LOOP AND MINIMIZATION OF ITS RADAR CROSS SECTION
Kun-mu Chen May 1965 38 p refs Prepared for Mich. Univ.
(Contract AF 33(615)-1656)
(TR-2; AD-467205)

A square loop is illuminated edge-on by a plane wave with its electric field vector parallel to the loop surface. The illumination can be divided into a symmetrical and an asymmetrical mode. The symmetrical mode induces a current of a dipole antenna made and the asymmetrical mode induces a current of a loop antenna mode in the loop. The total induced current in the loop is the sum of these two modes. The back scattered field of the loop is calculated and compared with the experimental results. The method of minimizing the radar cross section of a loop by a reactive loading technique is investigated. A similar technique is applied to a flat plate to reduce its radar cross section. Author

N65-31990# Advanced Development Labs., Inc., Nashua, N. H. Microwave Dept.
RESEARCH ON ELECTROMAGNETIC COMPATIBILITY TECHNIQUES Interim Engineering Report, 1 Dec. 1964–1 May 1965
B. L. Geddry [1965] 43 p refs
(Contract AF 33(615)-2076)
(IER-2; AD-462517)

The development of a linear Butler array antenna system with integral beam selector switch has been completed. The antenna and switch have been fully tested with good results. Phase II calls for the investigation of techniques for reduction of interference from sidelobes. Two techniques have been selected and all the electronic equipment necessary for testing them has been developed and checked out. The first technique, which only suppresses sidelobes, uses video comparison of pulses received from the multibeam antenna with pulses received from an omni-directional reference antenna. The second technique, which permits quite general pattern shaping and continuous beam steering, involves an ultra-rapid scan of all the beams within the integration time of the receiver. Author

N65-32040*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37-31, VOLUME III FOR THE PERIOD NOVEMBER 1 TO DECEMBER 31, 1964. THE DEEP SPACE NETWORK
31 Jan. 1965 105 p refs
(Contract NAS7-100)
(NASA-CR-64537; JPL-SPS-37-31, Vol. III) CSCL 09F

Supporting research and advanced development projects for the deep space network are described and include tracking stations engineering and operations, space flight operations facility, radio frequency systems development, communications engineering developments, communications research and development, and an advanced antenna system. R.N.A.

N65-32044*# Electromagnetic Research Corp., College Park, Md.
[ANTENNA RADIATION PROPERTIES AND ELECTROMAGNETIC PROPAGATION IN THE IONOSPHERE] Progress Report No. 1, 1 Oct.–31 Mar. 1965

[1965] 56 p refs
(Contract NASw-835)
(NASA-CR-64565) CFSTI: HC $3.00/MF $0.50 CSCL 09F

Current distribution, field patterns, and impedance of long antennas are investigated in studies related to ionospheric probing. Nonlinear effects of electron motion on antenna radiation are considered from the standpoint of diagnostics; and effects of finite thermal velocities of charged particles in the ionosphere on antenna properties are studied. In studying current distribution, directive patterns are considered and dispersion curves and their characteristics are given. Determination of far field and a second-order evaluation of far field are included. Impedance of an electrically small loop and loop impedance properties are discussed. It is concluded that a loop radiates more efficiently at VLF in the ionosphere than in free state. Radiation resistance of a small loop in the ionosphere varies only slightly with loop orientations; radiation resistance is many orders of magnitude greater than in free space. It is concluded that a properly designed loop can be an efficient antenna for VLF radiation in the ionosphere.
M.W.R.

N65-32074# Sylvania Electric Products, Inc., Williamsville, N. Y.
TRANSPORTABLE SATELLITE COMMUNICATIONS TERMINAL X-BAND RECEIVING FACILITY Final Report, 2 Mar. 1964–31 Mar. 1965
Robert Mc Intyre Griffiss AFB, N. Y., RADC, Jun. 1965 99 p refs
(Contract AF 30(602)-3333)
(RADC-TR-65-144; AD-618907)

This report describes the effort expended on the design, development, installation and testing of a X-band receiving facility for the Transportable Satellite Communications Terminal. The prime objective of this program was to provide the required demodulation capability for voice, frequency multiplex and frequency shift keyed signals to be generated during future Air Force test programs. The equipment resulting from this program includes a phased lock demodulator assembly which is used for frequency multiplex signals requiring a modulation index of one and a frequency feedback demodulator assembly which is used for a voice channel requiring a modulation index of 20. The designed demodulators provide an extension of the FM threshold over conventional frequency demodulation techniques, by approximately 4 db for the phase lock demodulator and by 7.2 db for the frequency feedback demodulator. The total receiving facility supplies a system noise temperature of 295° K over a tuning range of 7.69 to 7.79 gc and features automatic lock and tracking for signals having doppler frequency shifts of less than ±250 kc.
Author

N65-32080*# International Business Machines Corp., Rockville, Md. Federal Systems Div.
SPECIAL AROD SYSTEM STUDIES Third Quarterly Report
15 Apr. 1964 65 p refs
(Contract NAS8-11050)
(NASA-CR-64555; IBM-TR-23-137) CFSTI: HC $3.00/MF $0.75 CSCL 17B

Phase lock loop advanced circuits were investigated in connection with studies of Airborne Range and Orbit Determination (AROD) systems. The basis for evaluating inductance-capacitance (LC) versus crystal variable frequency oscillators (VFO) for AROD tracking filter application is presented. Design considerations for the LC-VFO circuit type phase locked loop are given. The VFO-multiplier circuit developed for a type II loop is reported; and the characteristics of type II loops and their impact on AROD problems are discussed. A continuing study of interface considerations between Saturn V Data Adapter (SVDA) and the AROD sensor is reported; and a method of achieving an interface with the Saturn Telemetry System, using capabilities achieved by the SVDA, is advanced. A preliminary report is presented on the study of linear coaxial capacity cavity amplifiers for the ground transponder transmitter.
M.W.R.

N65-32084*# Hallicrafters Co., Chicago, Ill.
STUDY OF COMMUNICATIONS SYSTEMS, AND DETECTION AND TRACKING SYSTEMS. DESIGN AND FABRICATION OF DYNAMIC CROSSED-FIELD ELECTRON MULTIPLYING LIGHT DEMODULATOR Periodic Progress Report No. 4, 20 Dec. 1964–20 Mar. 1965
M. Ross, R. Hankin, E. Dallafior, and R. Swenson [1965] 20 p
(Contract NAS5-3777)
(NASA-CR-64425) CFSTI: HC $1.00/MF $0.50 CSCL 17B

Results of an optical communications and tracking systems development program are presented. The microwave bandwidth dynamic crossed-field electron multiplier demodulator (DCFEM) was improved by reducing the spacing between the pedestal and secondary emission surface; this reduced the microwave drive power requirements to 1.75 watts. An evaluation of .005 mesh pedestal indicated the need for thicker mesh; replacement of the electromagnet with a permanent magnet is being considered; and a photosurface investigation was initiated. A manual covering radiation laws and statistics, noise and fluctuations, detection statistics and information theory aspects is being prepared.
R.W.H.

N65-32087*# Hallicrafters Co., Chicago, Ill.
STUDY OF COMMUNICATIONS SYSTEMS, AND DETECTION AND TRACKING SYSTEMS. DESIGN AND FABRICATION OF DYNAMIC CROSSED-FIELD ELECTRON MULTIPLYING LIGHT DEMODULATOR Periodic Progress Report No. 3, 20 Sep.–20 Dec. 1964
M. Ross, R. Hankin, E. Dallafior, and R. Swendsen [1964] 64 p refs
(Contract NAS5-3777)
(NASA-CR-64440) CFSTI: HC $3.00/MF $0.75 CSCL 17B

An analysis of laser communications, detection, and tracking systems, and development work on a microwave bandwidth dynamic crossed-field electron multiplier demodulator (DCFEM) are discussed. A detailed analysis of optical receiving techniques is included. Direct photodetection and photomixing are examined. Aspects of photomixing are presented, including spatial requirements, local oscillator power requirements, and the present status of photomixing. A comparison of photomixing and direct photodetection is made in which it is shown that the choice of a specific receiving technique must be determined for each particular application. Equations, charts, and graphs are provided. Results are given for an evaluation of factors affecting detector life and experimental data on DCFEM operation. A relatively stable detector was produced, and exhibits high current gain and good frequency response. The operating time for the tube is 100 hours.
C.T.C.

N65-32099*# Stanford Research Inst., Menlo Park, Calif.
A PRELIMINARY ANALYSIS OF FORWARD-SCATTER SIGNALS FROM SHOWERS Research Memorandum No. 5
A. S. Dennis and F. G. Fernald Oct. 1963 24 p refs
(Contract NASr-49(02))
(NASA-CR-55534) CFSTI: HC $1.00/MF $0.50 CSCL 17B

Simultaneous measurements of forward scatter by isolated showers at 4.86 and 9.10 Gc, made by the Central Radio Propagation Laboratory in Colorado, are analyzed with the aid of time-lapse photographic records from a weather radar. The computed scattering cross sections agree with those found by workers in the field of radar meteorology. Comparison of the received power at 4.86 Gc and 9.10 Gc provides definite evidence of non-Rayleigh scattering at 9.10 Gc, particulary near shower

cores at altitudes above the freezing level. On the basis of Mie scattering theory, the particles producing the most marked deviations from Rayleigh scattering are tentatively identified as dry hailstones some 1.5 cm in diameter. Author

N65-32111# European Space Vehicle Launcher Development Organization, Paris (France).
FORMULAE FOR POLYNOMIAL SMOOTHING IN WHITE NOISE
E. Cambi May 1965 23 p
(ELDO-TM-F-21)

Exact, and/or asymptotic, formulae are given expressing the smoothing weights and the expected variance in terms of: (a) the degree K of the smoothing polynomial; (b) the number N of the readings; with the assumptions that the readings are equidistant in time and the errors are *uncorrelated* ("white noise"). Formulae are written explicitly in some cases; in others, hints are given allowing formulae to be deduced without difficulty. Author

N65-32123*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TELEMETRY AND DATA PROCESSING SYSTEMS FOR SCIENTIFIC SATELLITES
Cyrus J. Creveling [1964] 9 p Presented to the Hopkins Student Branch of I.E.E.E., Baltimore, 30 Oct. 1964
(NASA-TM-X-54808) CFSTI: HC $1.00/MF $0.50 CSCL 09F

The various sizes, mission objectives, and complexities of scientific satellites are reviewed to show the need for the variety of telemetry systems used. The Satellite Telemetry Automatic Reduction System (STARS) Lines, which receive telemetry signals on analog tapes, digitize them, and place them on digital magnetic tapes for computer entry, are described. Additional steps in processing the data for the computer are also discussed. It is pointed out that data processing systems are in an evolutionary stage, and that close study of related problems is necessary to determine the most advantageous telemetry system to use for a specific type of data or with a specific satellite. M.G.J.

N65-32174*# Northeastern Univ., Boston, Mass.
THEORY OF THE RESISTIVELY LOADED TRAVELING WAVE V-ANTENNA Scientific Report No. 2
Sheldon S. Sandler 14 Jul. 1964 35 p refs
(Grant NsG-355)
(NASA-CR-58141) CFSTI: HC $2.00/MF $0.50 CSCL 09F

A preliminary report is presented for the essential parts of the theory of the resistively loaded travelling wave V-antenna. The principle of superposition and a new theory for long resonant antennas is applied to the prediction of the actual antenna current. As a first approximation, self and mutual impedances are derived. The radiation properties of the antenna are also presented for an assumed current. Machine calculations for the radiation properties have been verified by experiment. No numerical values for the actual antenna current and impedance are yet available for comparison with experiment. Author

N65-32178*# National Aeronautics and Space Administration, Washington, D. C.
LIGHT MODULATION AND ITS APPLICATION TO TELECOMMUNICATIONS
Gerard Marie Aug. 1965 27 p Transl. into ENGLISH from Mem. Soc. Ing. Civils France (Paris), v. 117, 1964 p 19–30
(NASA-TT-F-8762) CFSTI: HC $2.00/MF $0.50 CSCL 17B

The principles of light modulation and the interest light modulation offers for the long-distance transmission of information are reviewed. The main phenomena which can be brought into action for the achievement of this objective are indicated and the advantages presented by the linear electro-optical effect which appears in certain classes of crystals are discussed. Finally, the development of modulators intended for the transmission of one or more television circuits and the performances that can be expected from systems associated with He–Ne gas lasers are described. E.E.B.

N65-32187*# International Business Machines Corp., Rockville, Md. Federal Systems Div.
SPACE COMMUNICATIONS THEORY AND APPLICATIONS. VOLUME 4: SATELLITE AND DEEP SPACE APPLICATIONS A Bibliography
Richard F. Filipowsky and Louise C. Bickford, comp. Washington, NASA, Jul. 1965 303 p refs
(Contract NASw-981)
(NASA-SP-7022(04), Vol. 4) GPO: HC $1.75; CFSTI: MF $1.75 CSCL 17B

An annotated bibliography is presented covering communications satellites, instrumented satellites, deep space flight, and manned space flight with emphasis on the communications equipment and technology. The references relate to publications of a predominantly systems character. Hardware oriented publications have been, to a large degree, excluded to keep the bibliography within specified limits. E.E.B.

N65-32193*# International Business Machines Corp., Rockville, Md. Federal Systems Div.
SPECIAL AROD SYSTEM STUDIES Seventh Quarterly Report
15 Jul. 1965 68 p
(Contract NAS8-11050)
(NASA-CR-64554; IBM-TR-75-47) CFSTI: HC $3.00/MF $0.75 CSCL 17I

Technical summaries which present major conclusions of the phase lock loop advanced circuit investigations are presented. Both a technical summary of this task as well as a final report on analog memory-aided loop engineering model for alleviating the reacquisition problem occasioned by booster flame attenuation of the Airborne Range and Orbit Determination (AROD) signals are given. The final circuit configuration is discussed in detail. The performance obtained upon this model permits signal reacquisition delay intervals of the order of 100 milliseconds for worst case simulated signal conditions. This built-in loop memory of a Doppler rate estimate eliminates the penalties associated with instituting a search and acquisition cycle for relatively short duration signal fades. G.G.

N65-32202# Space Sciences, Inc., Waltham, Mass.
NANOSECOND PULSE BREAKDOWN IN GASES Final Technical Report
P. Felsenthal and J. M. Proud Griffiss AFB, N. Y., RADC, Jun. 1965 72 p refs
(Contract AF 30(602)-2779)
(RADC-TR-65-142; AD-618918)

It is shown analytically that under certain conditions pulsed dc and pulsed microwave breakdown are directly comparable. A pulsed dc experimental system to measure breakdown over a wide range of applied voltage, gas pressure and gap distance has been used to measure formative time in the different gases. For those gases where sufficient basic data are available comparison of theoretical and experimental results show good agreement. Breakdown measurements in air have been used to calculate breakdown field strengths as a function of altitude and frequency for pulse lengths of 1 to 100 nanoseconds. Author

N65-32219# Case Inst. of Tech., Cleveland, Ohio.
ELECTROMAGNETIC ASPECTS OF THE RE-ENTRY PROBLEM USING A WARM PLASMA MODEL Scientific Report No. 8
Norman C. Wenger Bedford, Mass., AFCRL, May 1965 97 p refs
(Contract AF 19(628)-1699)
(AFCRL-65-351; AD-618335)

The electromagnetic properties of a model of a re-entry plasma layer are determined using the linearized hydrodynamic equations for a single fluid warm plasma medium. The model consists of a perfectly conducting plane of infinite extent, representing the surface of a space vehicle, covered by a warm plasma layer of uniform density. The total fields excited by a magnetic line source located on the conducting plane are computed by Fourier transform techniques. Expressions are obtained for the energy transported by the radiation field and by the waves guided along the plasma layer. Numerical results are presented showing the dependence of the energy transport on frequency and electron temperature. In addition, the radiation pattern of the far zone field is computed for various values of frequency and electron temperature. Author

N65-32224# Sylvania Electronic Products, Inc., Waltham, Mass. Applied Research Lab.
WAVEGUIDE ADMITTANCE FOR RADIATION INTO PLASMA LAYERS-THEORY AND EXPERIMENT Scientific Report No. 8
Janis Galejs and Michael H. Mentzoni Bedford, Mass., AFCRL, Apr. 1965 26 p refs
(Contract AF 19(628)-2410)
(RR-451; S-3040-8; AFCRL-65-373; AD-618398)

Measured admittance of an X-band waveguide radiating into dielectric and plasma layers is compared with variationally computed admittance figures. The waveguide admittance measurements for polystyrene sheets of varying thicknesses compared closely with calculations. The admittance is computed first by assuming the principal waveguide mode and second by using a superposition of sine and shifted cosine waves as trail functions for aperture fields. Although the aperture fields are shown to differ significantly in the two cases, the computed admittance data are nearly the same because of the stationary character of the admittance expression. Author

N65-32227# Lowell Technological Inst. Research Foundation, Mass.
DEVELOPMENT OF SPECIALIZED RADIO RECEIVING APPARATUS, FREQUENCY CONTROL AND DATA RECORDING APPARATUS Final Report, 1 Feb. 1961–31 Oct. 1964
Klaus Bibl, Harriet Allen, and Gary Sales Feb. 1965 75 p refs
(Contract AF 19(604)-8371)
(AFCRL-65-261; AD-618305)

A system was developed and studies were made to obtain the maximum information concerning properties of the ionosphere by means of a beacon satellite. The satellite transmits CW at radio frequencies of 20, 40, and 41 MHz. Using a common oscillator the signals are phase coherent at the transmitter. Also, theoretical investigations were undertaken to study the scintillation in amplitude and phase caused by the interference pattern generated from irregularities in the ionosphere. A data reproduction and translation system was also developed to generate digital tapes for the computer analysis of scintillation measurements and to generate play-back time compressed records of 13 recorded signals for survey and interpretation. It was concluded that only a combined method of joining independent parameters, Faraday rotation, dispersive Doppler, and incidence measurements, can make the complicated behavior of the ionosphere understandable. E.E.B.

N65-32232# Naval Research Lab., Washington, D. C. Microwave Antennas and Components Branch.
A NONRECIPROCAL CIRCULAR POLARIZER Interim Report
M. L. Reuss 17 Jun. 1965 17 p refs
(NRL-6254; AD-618370)

A nonreciprocal circular polarizer has been developed. This ferrite device converts linear polarization propagating in rectangular waveguide into circular polarization propagating in circular waveguide. The sense, right- or left-hand, of the circular polarization is determined by the direction of a magnetic field applied to the ferrite. If one sense of circular polarization, e.g., right-hand, is transmitted, then only left-hand circular polarization can be received. Performance data indicate good ellipticity with reasonable loss and VSWR for two models of the circular polarizer, and for two devices—a circulator and a nonreciprocal antenna element—based on the polarizer. The antenna element permits one antenna to be used both to transmit and to receive the reflected circularly polarized signals from a target. Author

N65-32244# RAND Corp., Santa Monica, Calif.
ON AXIS FAR-FIELD BACKSCATTERING FROM FLARED AXIALLY SYMMETRIC BODIES
Herschel Weil and Joseph L. Raymond Jul. 1965 31 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4373-PR; AD-618366)

A physical-optics solution for the backscattering from a concave ring singularity is presented for determining the radar echo from a body of revolution. The problem, where the cone is followed by a frustum of a cone having and included angle greater than that of the forebody (thus forming a concave ring singularity) is treated. When taken together with the solution for a convex singularity, the solutions provide a simple method for estimating the backscattering from ring singularities of almost every type. The solutions offer many important applications to radar returns from rings. L.S.

N65-32276*# National Aeronautics and Space Administration, Washington, D. C.
SOME PRINCIPLES FOR ALLOCATING THE RADIO-FREQUENCY SPECTRUM AND FORMULATING PLANS FOR VARIOUS RADIO SERVICES
A. L. Badalov Aug. 1965 21 p refs Transl. into ENGLISH from Elektrosvyaz (Moscow), v. 19, no. 3, 1965 p 1-12
(NASA-TT-F-9552) CFSTI: HC $1.00/MF $0.50 CSCL 17B

Survey of the principles underlying the allocation of frequency bands for space radio communications and other radio services. Examples of the simultaneous use of the same frequency bands by radio, TV, and fixed and mobile service are cited. The methods used to define the necessary distance between ground stations for space communications and other services are examined. Author

N65-32278# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ENGINEERING-TECHNICAL REFERENCE BOOK ON ELECTRICAL COMMUNICATION (CHAPTERS 5 AND 11, AND APPENDIX 2)
V. V. Novikov, G. F. Zubovskiy, V. S. Kogan, and N. I. Voronin 29 Apr. 1965 109 p Transl. into ENGLISH from "Inzh.-Tekhn. Spravochnik po Elektrosvyazi, Telegrafiya" USSR, Gos. Izd. Lit. po Voprosam Svyazi i Radio, 1963 p 292-327, 471-526, 632
(FTD-MT-64-182; AD-618090)

The automation of telegraph communications and the central telegraph station are described in these two chapters from the basic reference book on electrical communications.

Automatic, semiautomatic, and direct coupling systems and the telegraph exchange with coded commutation of telegrams are discussed. Constructional design, equipment distribution, instrumentation, illumination, and mechanization are considered for telegraph facilities. E.E.B.

N65-32284# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
WHAT DO SEMIOTICS SPEAK ABOUT?
A. Kondratov 15 Jul. 1965 17 p ref Transl. into ENGLISH from Znanie Sila (Moscow), no. 3, 1963 p 10–13
(FTD-TT-65-326/1+4; AD-618312)

The science of symbols or signs is discussed as a language for the communication of humans, animals, and inanimate objects. Its use in mathematics, cybernetics, and automation is considered. E.E.B.

N65-32299# Lenkurt Electric Co., Inc., San Carlos, Calif.
INTERCONNECTING GROUPS OA-7021(XW-1)/FCC-17, OA-7151(XW-1)/FCC-17 AND OA-7152(XW-1)/FCC-17 (SUPERGROUP INTERCONNECT PANELS), PHASE A Final Technical Report
Forrest N. Easley, Frank Hegarty, and T. R. Holmes 1 Jul. 1965 41 p
(Contract AF 30(635)-11188)
(RADC-TDR-64-470, Vol. I; AD-618417)

This report contains a chronological summary of the design and development problems and a detailed theoretical discussion of the supergroup interconnect panel. The supergroup interconnect panel was designed and developed for insertion in the transmission path between the supergroup demultiplexer output of a given supergroup in the AN/FCC-17 terminal equipment and the supergroup multiplexer input of the same AN/FCC-17 terminal equipment or of a given supergroup in a commercial "L" multiplex system. One supergroup interconnect panel must be used for each direction of transmission of a 60-channel supergroup. The predicted Mean-Time-Between-Failure of each supergroup interconnect panel is 5590 hours and the Point-Availability is 99.995 percent. Author

N65-32327# California Univ., Livermore. Lawrence Radiation Lab.
AIRBORNE SCAN-CONVERTER SYSTEM
Stanley W. Thomas 13 Oct. 1964 27 p refs
(Contract W-7405-ENG-48)
(UCRL-7952; CONF-799-4)

A method of converting very high bandwidth, single-transient information in a rocket-borne experiment to a much lower bandwidth is described. Application of the scan conversion technique to single-transient information of nanosecond rise time permits conversion to bandwidths commensurate with present day telemetry systems. Signal-storage rise time capability is 1 to 10 ns depending on the type of storage tube used. Of special interest is the unique transistorized linear sweep. Its delay between trigger and start of the sweep is less than 6 ns and the sweep voltage is ±400 volts. Other transistorized circuitry, such as readout sweep, time base generator, and signal amplifier, is also discussed. Author

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N65-31449# Joint Publications Research Service, Washington, D. C.
EXTENSION OF A SET-THEORETIC MODEL TO LANGUAGES WITH GRAMMATICAL HOMONYMITY
I. I. Revzin 12 Jul. 1965 19 p refs Transl. into ENGLISH from Nauch-Tekhn. Inform. (Moscow), no. 3, 1965 p 34-38
(JPRS-31028; TT-65-31526) CFSTI: $1.00

The formalization of grammatical concepts in machine language translations has led to the development of a set-theoretic model. While this model has aided many linguistic problems, it has encountered difficulties related to posing a set of signed sentences as well as those related to homonyms and certain grammatical concepts. A series of theorems concerned with homogeneous languages is presented. It is observed that natural languages are usually restrictedly homogeneous and, therefore, also partially and practically homogeneous. Proofs are then given to show that every completely homogeneous language is both restrictedly homogeneous and paradigmatically complete. When these last two conditions exist, it is proven that the language is completely correct. Determination of genus in a restrictedly homogeneous language and grammatical categories are discussed. M.W.R.

N65-31611# Aerojet-General Corp., Sacramento, Calif. Grain Design Section.
THE INTEGRATED DESIGN COMPUTER PROGRAM AND THE ACP-1103 INTERIOR BALLISTICS COMPUTER PROGRAM
T. R. Threewit, R. A. Rossini, and R. L. Vecker 1 Dec. 1964 379 p
(Contract DA-04-200-ORD-1305(Z))
(STM-180; AD-466965)

The Integrated Design and the ACP-1103 Interior Ballistics Digital Computer Programs are described. The Integrated Design Program converts a mission concept (range and payload) into a complete missile design, including the number of stages, diameters, lengths, and weights. The final design is optimized with respect to key parameters, and contains a grain design and a real propellant. The Integrated Program is a continuing effort to automate procedures for designing solid rocket systems, and its computer program reproduces human functions involved in conducting preliminary missile and propulsion design. The ACP-1103 Computer Program provides an incremental solution to the problem of one-dimensional gas flow with mass addition in a propellant bore. To achieve this solution, the designer must know the ballistic properties of the propellant, must have a description of all ballistically significant parameters (throat area, firing temperature, and atmospheric pressure), and has to input an axially incremented description of burning-surface area and area of gas flow for each time point in the burning traverse of the grain. For grain designs of a more common type, the program automatically calculates these surface areas and areas of flow down the grain bore. R.R.D.

N65-31640# Rocketdyne, Canoga Park, Calif.
DESIGN, TESTING AND ESTIMATION IN COMPLEX EXPERIMENTATION. IV: A COMPUTER ROUTINE FOR EVALUATING INCOMPLETE FACTORIAL DESIGNS
S. R. Webb and S. W. Galley Wright-Patterson AFB, Ohio. Aerospace Res. Labs., Jun. 1965 75 p refs
(Contract AF 33(616)-7372)
(ARL-65-116, Pt. IV; AD-618518)

A computer program for the evaluation of incomplete factorial experimental designs for a specified experimental situation is described. This program allows any number of alternative designs to be compared on the basis of variance or alias characteristics with a minimum of effort. Several different models, which differ in the interactions to be estimated, may be used. The designs may have up to 64 runs, and up to 64 parameters may be estimated; however, detailed instructions

are included on how these and other limitations may be changed. The program takes a maximum of 1 minute of execution time per design-model combination, but for a moderate number of parameters takes much less (3 seconds for 25 parameters). It is programmed in the Fortran IV system for the IBM 7090 computer. Author

N65-31664 Joint Publications Research Service, Washington, D. C.
CHARACTERISTICS OF TRANSFLUXOR OPERATION
L. V. Safris *In its* Izv. VUZov: Instr. Building, Vol. VIII, No. 3, 1965 p 105–110 refs (See N65-31650 20-14) CFSTI: $5.00

Some experimental data are presented on the operation of transfluxors with alternating current excitation. Author

N65-31665 Joint Publications Research Service, Washington, D. C.
EFFECT OF POWER SUPPLY INTERNAL RESISTANCE ON DECODING ACCURACY
S. F. Svinin *In its* Izv. VUZov: Instr. Building, Vol. VIII, No. 3, 1965 p 111–118 refs (See N65-31650 20-14) CFSTI: $5.00

A study is made of the effect of power supply internal resistance on the accuracy of operation of a code-voltage converter for two types of decoding grids. Substantiation is given for the requirements on the values of the digital controlled resistors (DCR). Author

N65-31694# Naval Research Lab., Washington, D. C.
LIGHT-PENCIL COORDINATE POSITIONER
F. R. Fluhr Mar. 1965 20 p refs
(NRL-MEMO-1592; AD-460781)

A number of data-processing operations require the rapid and accurate extraction, control and coordination of position data from cathode ray tube information sources such as radar and IFF PPI repeaters and computer displays. A light pencil which detects and controls a position- and intensity-modulated marker presented on the cathode ray tube screen during the indicator retrace period has been devised. The coordinates of this marker may be used to position the video gate which extracts desired signals from the radar/IFF returns without requiring the operator to hold the pencil in position. The light pencil operates independently of the PPI repeater range controls and therefore requires no elaborate gain tracking devices in order to maintain a one-to-one light pencil motion to marker motion. Except for the light detection photomultiplier, the entire design is solid state. Author

N65-31881# Texas Instruments, Inc., Dallas.
FABRICATION AND TESTING OF CRYOGENIC ASSOCIATIVE PROCESSOR PLANES Final Report, 5 May–13 Dec. 1964
J. Paul Pritchard, Jr. Griffiss AFB, N. Y., RADC, May 1965 56 p refs
(Contract AF 30(602)-2608)
(TI-08-65-11; RADC-TR-65-74; AD-618491)

The feasibility of a unique photomask-photoresist process for fabrication of a 120-bit, 2350-cryotron associative memory plane has been established. A set of nine photomasks defines the five superconductive and four insulating material layers of the structure. The thin film circuitry occupies a 4 square inch area of a 2.4 inch × 2.4 inch glass substrate. Two hundred and fifty solder lands, 0.007 inch × 0.100 inch on 0.014 inch centers, are suitably grouped around the substrate perimeter for pressure contact with the data link. Seven short-free memory planes were successfully produced with intended signal path continuity, as established by dc tests at 300° K and below 3.5° K. Difficulties in simultaneously achieving superconductive pressure contact at all solder lands precluded memory operation; however, current loop switching and trapping were demonstrated for accessible cryotron circuit segments. Solutions to this unanticipated interconnection problem were subsequently conceived and demonstrated. Author

N65-31883# Dunlap and Associates, Inc., Darien, Conn.
DATA FILE SIZE AND ITS RELATION TO THE BAYESIAN EFFECTIVENESS OF AN INFORMATION RETRIEVAL SYSTEM Interim Report, 16 Feb.–15 Apr. 1965
Ugo O. Gagliardi Bedford, Mass., AFSC, Electron. Systems Div., Apr. 1965 85 p refs
(Contract AF 19(628)-5057)
(ESD-TR-65-275; AD-618311)

A simple Bayesian measure of system effectiveness for information retrieval systems is proposed. The measure combines the recall and precision ratios of an information system with the utility structure of the system user. Using the measure, it is possible to show that effective systems are possible only under a very narrow set of conditions. In particular, it is shown that using present state-of-the-art indexing, it is not possible to have effective systems with file sizes much in excess of 100,000 documents. Author

N65-31912# Pisa Univ. (Italy).
STUDY OF CALCULATION PROCESSES IN THE ARITHMETICAL UNITS OF ELECTRONICS COMPUTERS [STUDIO DI PROCESSI DI CALCOLO NELLE UNITA' ARITMETICHE DEI CALCOLATORI ELETTRONICI]
M. Falleni and L. Pistelli Brussels, EURATOM, 1965 27 p refs In ITALIAN; ENGLISH summary
(Contract EURATOM-027-61-12 CETI)
(EUR-2153.i) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 50 Belg. Fr.

This study is a first attempt to clarify certain problems which arise in connection with the arithmetical units in numerical electronic computers. The first part compares some of the best-known numerical representation systems with the object of demonstrating their most important features and the problems which arise in arithmetical operations. The second part considers a redundant codified representation system for the numerical quantities connected with multiplication processes; there is a discussion of some of the best-known achievements in connection with this system of redundant representation. The third part deals with division processes. It discusses some aspects of problems connected with the redundant representation of numbers. Author

N65-31920# European Atomic Energy Community, Brussels (Belgium).
A PREDICTING COMPUTER—EXAMPLE OF A LEARNING MACHINE [LE PREDICTOR—EXEMPLE D'UNE MACHINE QUI APPREND]
M. Combet and L. Verbeek 1965 84 p refs In FRENCH; ENGLISH summary
(EUR-2405.f) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 125 Belg. Fr.

In the first part some theoretical considerations on the general ideas of a predicting network are given, together with an overall description on the basis of a block diagram. The rest of this report is a rather complete description of the realization of a special digital computer by means of electronic circuits. This computer is capable of predicting a 12-bit binary word of a pattern consisting of a sequence of up to 24 words. Upon receiving a given word of the pattern the computer gives as output a word forming its prediction of the next word. The prediction is based on the functional change of the network. Author

N65-31923# Universita Commerciale Luigi Bocconi, Milan (Italy).
OPERATORS AND PROCEDURES IN ALGOL-TYPE LANGUAGES
L. Petrone Brussels, EURATOM, 1965 9 p refs
(Contract EURATOM-015-61-5 CETI)
(EUR-2417.e) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 25 Belg. Fr.

Full use of call by name of parameters in ALGOL 60 is analyzed. Inconveniences are shown and an alternative proposal is made. This proposal avoids the need of a prescribed order of evaluation of primaries in the arithmetic expressions of ALGOL and provides a clear functional notation. Author

N65-31930# General Electric Co., Bethesda, Md. Information Systems Operation.
AIR FORCE PERSONNEL SYSTEM AND DISPLAY CONSOLE STUDY Final Report
D. V. Torr, M. V. Russell, H. G. McGuire, and E. E. Howard 28 Jul. 1965 220 p
(Contract AF 41(609)-2628)
(FR1-168-10)

The personnel system of the Air Force was analyzed to identify variables necessary for the effective management of personnel. Information flow within the personnel system was identified. A set of cathode ray tube display formats were developed for use in a personnel forecasting model. Functional equipment specifications for a display console compatible with the IBM 7040 computer are presented. R.N.A.

N65-32072# Massachusetts Inst. of Tech., Cambridge.
A DEMONSTRATION HYBRID COMPUTER FOR REAL-TIME FLIGHT SIMULATION Final Report, May 1961–Aug. 1964
Mark E. Connelly and Oleg Fedoroff Wright-Patterson AFB, Ohio, ARML, Jun. 1965 196 p refs
(Contract AF 33(616)-8363)
(AMRL-TR-65-97; AD-618706)

A hybrid, real-time simulation facility has been designed, constructed, and demonstrated, using as a test vehicle the complete aerodynamic and engine equations for a high-performance military aircraft. The analog-digital configuration employs peripheral analog equipment to represent a linear, skeleton version of the aircraft and the PDP-1 digital computer to carry out engine simulation, decision management, and corrections for nonlinear effects. This report presents a detailed description of the hybrid design, the F-100A model, the system components, the PDP-1 programs, and the test phase. Tutorial discussions of scaling, key algorithms, model making, logical design, and the state-of-the-art in hybrid components are also included. Author

N65-32125# Pennsylvania State Univ., University Park. Ordnance Research Lab.
DESIGN AND ANALYSIS OF AN ULTRA-HIGH SPEED, TUNNEL DIODE, DIGITAL TO ANALOG CONVERTER (DECODER)
J. A. Macaluso 18 May 1965 241 p refs
(Contract NOw-65-0123-d)
(TM-615.3271-05; AD-617731)

The capabilities and limitations of a tunnel diode as applied to an ultra-high speed binary weighted ladder decoder were studied. The suitability of a tunnel diode controlled gate circuit for implementing the binary sources of a current mode decoder was established. Equations describing decoder errors, static design procedures, and dynamic operation were developed from theoretical considerations; and a design example demonstrating the evaluation of the equations for representative parameter values was included. Digital computer programs were developed to solve both static and dynamic nonlinear equations of state. It was shown that a decoder accuracy of better than one part in 10^3 and data rates up to 5×10^8 bits/sec (to 5% accuracy) can be obtained with available components and relatively unsophisticated construction techniques. L.S.

N65-32228# Naval Weapons Lab., Dahlgren, Va. Computation and Analysis Lab.
EXPECTED COVERAGE OF A CIRCULAR TARGET BY BOMBS ALL AIMED AT THE CENTER
M. P. Jarnagin, Jr. 30 Jun. 1965 167 p
(NWL-1941; AD-618877)

The exact mathematical formulation is derived for the expected proportional coverage of a circular target from n weapons all aimed at the center of the target. It is assumed that the weapons fall in a circular normal distribution and that the lethal area of each weapon is a circle of specified radius (cookie-cutter lethality function). Tables are presented which are based on this formulation and which were computed on an IBM 7030 (STRETCH) computer. The computing time per case for coverages correct to two decimal digits is 0.25 to 0.50 seconds. Author

N65-32231# Rome Air Development Center, Griffiss AFB, N. Y. Communications Research Branch.
AN INTRODUCTION TO CODES FOR QUANTIZED FREQUENCY TRANSMISSIONS
Alfred S. Kobos Jun. 1965 15 p refs
(RADC-TR-65-250; AD-618912)

This paper discusses possible code structures which can be utilized in systems using quantized frequency transmission as a modulation technique. Simple examples of codes are shown, and a general approach to a study of this area is suggested. Two specific codes are exhibited; one is an equal-distance maximum-distance code which contains the largest possible number of words, and the other is a code derivable from maximum length pseudo-random sequences. Being a preliminary report, only the most elementary notions are presented, and an introduction to the subject is developed, without extensive investigation of all possible facets of this subject. Author

N65-32296# System Development Corp., Santa Monica, Calif.
PRESERVATION OF LANGUAGES BY TRANSDUCERS Scientific Report No. 3
Seymour Ginsburg and Gene F. Rose 15 Mar. 1965 41 p refs
(Contract AF 19(628)-3418)
(SDC-TM-738/013/00; AFCRL-65-402; AD-618397)

A linear bounded transducer (pushdown transducer) is a linear bounded automaton (pushdown automaton) with outputs. Answers to the following two problems are derived in the paper: (1) If S is a linear bounded transducer or a pushdown transducer, and L is context sensitive, context free, or regular, is S(L) some well known type of set? (2) Does there exist a decision procedure to determine for arbitrary sets L_1 and L_2, both context sensitive or both context free, whether there exists a linear bounded transducer (pushdown transducer) which maps (a) L_1 onto L_2 or (b) L_1 into L_2 nontrivially? Author

N65-32297# Mitre Corp., Bedford, Mass.
LOGICAL DESIGN FOR FAST SERIAL COMPUTER
H. B. Enderton Jul. 1965 80 p
(Contract AF 19(628)-2390)
(W-07189; ESD-TR-65-81; AD-618933)

The detailed logical design is given for a serial digital computer using a 0.5-microsecond magnetic memory, 100-mc logical circuits, and one-word delay lines. The computer performs most instructions in 1 microsecond. A list is given of the amount of hardware used. Author

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N65-31287 Joint Publications Research Service, Washington, D. C.
FREQUENCY CONVERSION IN TWT AND BWT
B. Ye. Zhelezovskiy *In its* Izv. VUZov: Radiofiz., Vol. VIII, No. 2, 1965 10 Aug. 1965 p 129–140 refs (See N65-31275 20-23) CFSTI: $6.00

A frequency converter for TWT and BWT is discussed. The characteristic equation of the converter is obtained and analyzed. The initial conditions are formulated and the amplitude distribution of the waves of current, velocity and voltage over the interaction space are written in general form. Author

N65-31298 Joint Publications Research Service, Washington, D. C.
DESIGN OF RESONATORS AND WAVEGUIDES WITH A MULTILAYER DIELECTRIC
G. F. Semenov *In its* Izv. VUZov: Radiofiz., Vol. VIII, No. 2, 1965 10 Aug. 1965 p 249–252 refs (See N65-31275 20-23) CFSTI: $6.00

Expressions are obtained by a field method for the design of resonators and waveguides with any number of dielectric layers as long as these layers are located parallel to the end walls of the resonators or waveguides. The constant of propagation for a rectangular five-layer dielectric is considered, and the resultant expression is shown to be valid for circular and coaxial cases. M.W.R.

N65-31485 Naval Research Lab., Washington, D. C.
NRL CENTRALIZED ELECTRONIC CONTROL PACKAGING
D. A. Venn, E. Toth, and J. S. West *In its* Rept. of NRL Progr. May 1965 p 8–19 refs (See N65-31483 20-34)

The development of new techniques in electronic equipment packaging is described. This form of packaging implements the principle of functional modularization of the basic electronic circuits, and also implements the assembly and interconnection of the modules in modular racks and cabinets grouped in a central location to provide equipment and system functions. The heat exchanger modules that provide the cold air for cooling the electronic modules, and the wiring-interface modules that connect the entire assembly to the ship's power system are mounted as slide-out elements of modular cabinets. Modular elements designed in accordance with these concepts, including the interconnection devices, are presented. As part of a program in Centralized Electronic Control (CEC), concentrated efforts were made to build in flexibility and growth potential to cope with possible future technological advances, and to demonstrate that integrated packaging can meet the requirements for utmost reliability, flexibility, compatibility, maintainability, and economy of electronic systems. R.R.D.

N65-31491# Varian Associates, Beverly, Mass.
THALLIUM BEAM TUBE RESEARCH Quarterly Progress Report, 1 Jan.–30 Apr. 1965
Richard F. Lacey [1965] 19 p refs
(Contract DA-28-043-AMC-00350(E))
(QPR-3; AD-618105)

Task I. Additional testing of an iridium ionizer showed an ionization efficiency for thallium of 3.7% depending markedly on ambient pressure at lower temperatures. Attempts were made to deposit higher work function coatings on tantalum, but the deposits did not adhere. Other possible methods of ionizing a thallium beam have been studied. Task II. Tests on an X-band model of a proposed thallium waveguide structure showed the necessity for adequate mode suppression in order to use the coaxial design. Further, the extension of the bare quartz inner cylinder in a region of high electric field in the ends of the cavity appears to be unsatisfactory. Calculations were made on the perturbation caused by putting the cylinder at the electric field null of a cavity operating in the TE_{021} mode. Task III. A prototype quadrupole magnet is under construction. Author

N65-31507 Airtron, Inc., Morris Plains, N. J.
MICROWAVE COMPONENTS FOR COMMUNICATIONS SYSTEMS
Feb. 1965 31 p
(R11-457)

Microwave components and transmission line elements designed for line-of-sight, troposcatter, and space communications systems are described. Descriptions are included on flexible and rigid waveguides, high and low power ferrite isolators, fixed-tuned and tunable bandpass filters, band-reject filters, low-pass filters, mechanical switches, and high and low power dummy loads. Typical performance specifications are tabulated for all microwave components and transmission line elements needed for communications systems. R.N.A.

N65-31582# Illinois Univ., Urbana. Coordinated Science Lab.
MEMORY EFFECTS IN THE CURRENT-VOLTAGE CHARACTERISTICS OF THIN FILM SANDWICHES
George Riddle Jul. 1964 22 p refs
(Contract DA-28-043-AMC-00073(E))
(R-219; AD-443854)

Some new electrical effects have been found in thin insulating films sandwiched between metal film electrodes. Most of the measurements were made on Al–Al_2O_3–Au three-layer devices which were produced by vacuum deposition and anodization. The dielectric thickness was 100 to 1000 angstroms. Electrical measurements were made in darkness and under vacuum. Currents through the insulator were measured as a function of applied voltage. Fresh films displayed an exponential dependence of current on voltage at low voltages. If the sandwiches were exposed to more than a few volts, they underwent an irreversible "forming" process. The "formed" sandwiches displayed interesting current-voltage relationships, including instabilities, negative resistance, and memory effects. Author

N65-31607# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HIGH-SPEED TRANSISTORIZED MAGNETIC AMPLIFIER
F. D. Kochubiyevskiy 9 Jan. 1965 4 p Transl. into ENGLISH from Soviet Patent No. 159198 (Appl. No. 807555/24-7, 11 Dec. 1962 2 p
(FTD-TT-64-684/1+2; AD-455512)

A rapid-action transistorized magnetic amplifier is proposed in which the windings of the control and damping are connected to the general source of the signal through emitter repeaters on compound transistors. This arrangement makes possible better use of the active materials of the amplifier and a reduction in dimensions. The brief description of this device includes a circuit diagram of the amplifier. J.M.D.

N65-31621# Sprague Electric Co., North Adams, Mass.
FEASIBILITY STUDY OF METAL BASE TRANSISTOR, PHASE II First Quarterly Report, 20 Jan.–30 Apr. 1965

J. J. Casey, F. L. Vogel, and P. M. Kennedy [1965] 32 p refs
(Contract DA-28-043-AMC-00168(E))
(Rept.-2; AD-619143)

The molybdenum-silicon phases produced by chemical vapor deposition of molybdenum on (111) Si substrates have been investigated by electron diffraction, microwave absorption, and electron microscopy. Details of some of these phases have been determined, and important differences in the resistance of (100) Si and (111)Si surfaces to molybdenum penetration have been noted. In at least one case, a layer deposited at 700° C has retained its metallic character after being heated to 1200° C. Author

N65-31651 Joint Publications Research Service, Washington, D. C.
LOW-VOLTAGE THIN-FILM NONLINEAR ELEMENTS
Yu. N. Balodis and V. V. Pasynkov *In its* Izv. VUZov: Instr. Building, Vol. VIII, No. 3, 1965 p 10–16 refs (See N65-31650 20-14) CFSTI: $5.00

The properties of low voltage thin film nonlinear elements fabricated from amorphous silicon films by vacuum evaporation are considered. R.N.A.

N65-31652 Joint Publications Research Service, Washington, D. C.
RANDOM SIGNAL CORRELATION FUNCTION DISTORTION BY A NONLINEAR AMPLIFIER
V. I. Vinokurov and Yu. A. Gustov *In its* Izv. VUZov: Instr. Building, Vol. VIII, No. 3, 1965 p 17–24 refs (See N65-31650 20-14) CFSTI: $5.00

A study is made of the distortion of the autocorrelation function of a noise intensity having a Gaussian probability density distribution on passage through an amplifier with nonlinear amplitude characteristic which is approximated by a broken line. Curves are plotted which characterize the variation of the correlation function distortions with the ratio of the intensity of the incoming signal to the voltage corresponding to the boundary of the linear portion of the amplitude characteristic of the amplifier. Author

N65-31653 Joint Publications Research Service, Washington, D. C.
THE USE OF ELECTRONIC COMPUTERS FOR THE SELECTION OF STRUCTURES OF QUASIBALANCED BRIDGES PROVIDING FOR SEPARATE MEASUREMENT OF THE COMPONENTS OF THE COMPLEX IMPEDANCE
T. A. Zhuravleva, K. B. Karandeyev, and G. A. Shtamberger *In its* Izv. VUZov: Instr. Building, Vol. VIII, No. 3, 1965 p 25–33 refs (See N65-31650 20-14) CFSTI: $5.00

The desirability of the use of computers for the analysis of complex bridge networks is shown, based on the possibility of separate measurement of the components of the total impedance. A block diagram of a program for the analysis of such networks on an electronic computer is presented. Author

N65-31654 Joint Publications Research Service, Washington, D. C.
AN AUTOMATIC SYMMETRICAL BALANCED BRIDGE
A. A. Kol'tsov and D. N. Karabanov *In its* Izv. VUZov: Instr. Building, Vol. VIII, No. 3, 1965 p 34–38 refs (See N65-31650 20-14) CFSTI: $5.00

Design formulas and the comparative characteristics are presented for two versions of a symmetrical bridge whose calibration is independent of the communication line parameters. Author

N65-31659 Joint Publications Research Service, Washington, D. C.
THE DESIGN OF STEPPING EXTREMAL REGULATOR CIRCUITS USING DIGITAL ELEMENTS
N. N. Atamanenko and P. I. Akinin *In its* Izv. VUZov: Instr. Building, Vol. VIII, No. 3, 1965 p 73–78 refs (See N65-31650 20-14) CFSTI: $5.00

A description is presented of the circuit of a digital extremal regulator with a pulse-counting method of converting the controlled quantity into a digital equivalent with the use of a reversing counter in a comparison circuit. A variant is presented of a non-summation comparison circuit in the case when the values of the regulated quantity are represented in the form of a digital code. Author

N65-31662 Joint Publications Research Service, Washington, D. C.
ANALOG AVERAGER OF DISCRETE VOLTAGES
A. I. Simkhes, L. K. Gudin, and E. Ye. Smirnov *In its* Izv. VUZov: Instr. Building, Vol. VIII, No. 3, 1965 p 94–100 refs (See N65-31650 20-14) CFSTI: $5.00

A description is given of an analog averager for discrete voltages with storage of the sample average; the averager is unique in that the summation of the sample elements is accomplished by adding the voltages on the condensers of the memory cells, and finding the sample average of a large volume is accomplished by averaging of the sample averages of smaller quantities. The specifications of the averager are presented. Author

N65-31663 Joint Publications Research Service, Washington, D. C.
CIRCUIT OF A BINARY COUNTER WITH SEPARATE TRIGGERING WITHOUT A DELAY LINE
V. A. Lopukhin *In its* Izv. VUZov: Instr. Building, Vol. VIII, No. 3, 1965 p 101–104 (See N65-31650 20-14) CFSTI: $5.00

We consider the circuit of a binary pulse counter fabricated using semiconductor triggers with separate base triggering in which high frequency delay lines are not used. Test data for the circuit are presented. Author

N65-31671 Joint Publications Research Service, Washington, D. C.
CONTACTLESS THERMOREGULATORS USING SEMICONDUCTOR THERMOSENSORS FOR ELECTRIC RESISTANCE HEATERS
A. V. Donskoy, I. Sh. Lutsker, and V. V. Smorodinov *In its* Izv. VUZov: Instr. Building, Vol. VIII, No. 3, 1965 p 149–156 refs (See N65-31650 20-14) CFSTI: $5.00

This paper is devoted to the questions of the design of contactless thermoregulators for low-temperature electric resistance heaters using as the thermosensors the semiconductor thermistors, diodes and triodes, and using semiconductor controlled power diodes to meter the electric power. Author

N65-31688# Bell Telephone Labs., New York.
ENGINEERING SERVICES ON TRANSISTORS Eighth Quarterly Progress Report, 1 Jan.–31 Mar. 1965
S. R. Arnold, H. J. Boll, C. R. Crowell, J. E. Iwersen, B. T. Murphy et al
30 Jun. 1965 94 p refs
(Contract DA-36-039-AMC-02227(E))
(Rept.-20; AD-466171L)

Development of new and improved transmission-type transistors, functional devices, and integrated circuits was continued. The influence of contact resistance on unilateral gain was analyzed, and the importance of developing base contacts with extremely low ohmic resistance was demonstrated.

Contact studies were carried out on specially designed structures that facilitate quantitative evaluation of various metal contact systems. Low-resistance contacts using an intermetallic copper–germanium layer were developed, and devices having 2.5-micron-wide emitter stripes were fabricated with the new contacting technique. The devices exhibit improved performance over earlier structures. A current limiter having higher speed and higher current per unit area of chip than field-effect types, was fabricated, using planar Ge technology; theoretical calculations of optical-phonon scattering effects in the emitter and collector semiconductors of hot-electron transistors were made; and ultra-high-speed nonsaturating monolithic logic-circuit designs are described. L.S.

N65-31700# ITT Industrial Labs., Fort Wayne, Ind.
RESEARCH AND DEVELOPMENT TO IMPROVE THE RESOLUTION OF IATRON DIRECT VIEW STORAGE TUBES, PHASE II Summary Development Report, Mar. 2, 1964–Jun. 2, 1965
R. W. Hunter 1 Jul. 1965 46 p ref
(Contract NObsr-87264)
(AD-617538)

Work was directed toward improving the resolution of direct view storage tubes and applying the results to a 5-inch magnetically focused and deflected tube with improved resolution. Six sample tubes were built containing improved writing guns, 500 mesh 50-percent transmission collector screens, and 1000 mesh 25-percent transmission backing electrodes. All tubes had a 0.150 inch backing electrode-to-viewing screen spacing. A resolution of 150 raster lines per inch at a 1000 foot-lamberts brightness was achieved, and a general increase in resolution at all brightness levels was also achieved. The new tube design is capable of more than 200 raster lines per inch at 10-percent of saturation brightness, and reduces to about 85 raster lines per inch at 90-percent of saturation. This improvement in resolution was attained by improving the writing gun and modifying the image section to prevent resolution degradation. The writing gun was improved by reducing the grid aperture and modifying other parameters to maintain the desired cutoff and current characteristics. R.R.D.

N65-31747# Sandia Corp., Albuquerque, N. Mex.
A RADIATION HARDENED TELEMETRY SYSTEM
V. K. Smith and D. L. Trapp Jun. 1964 8 p
(Contract AT(29-1)-789)
(SC-R-64-178)

This paper describes a solid-state FM/FM telemetry system developed under the direction of Sandia Corporation which will survive and operate within specifications through a pulsed radiation environment of 10^{14} neutrons per square centimeter (nvt) energies greater than 10 Kev. The system will recover from an associated gamma pulse of approximately 10^{12} roentgens (R) per second in less than 5 milliseconds, and operate within specifications through a 125-g, 3 millisecond shock pulse. The method of development is described and test results are given. Author

N65-31826# Sandia Corp., Albuquerque, N. Mex. Sandia Lab.
PROPERTIES OF FERROELECTRIC CERAMICS UNDER HIGH STRESSES (AXIAL MODE)
A. E. Binder Feb. 1964 26 p refs
(Contract AT(29-1)-789)
(SC-TM-357-63(13))

Some of the electrical properties of ferroelectric ceramics were measured over a range of stresses from about 2 to 500 kilobars. The charge release was found to depend on stress for both a modified barium titanate and lead zirconate titanate ceramic, with optimum characteristics in the neighborhood of 20 kilobars for barium titanate and 10 kilobars for the lead zirconate titanate. The conductivity induced by stress was the cause of less than full charge release. The conductivity and high frequency permittivity were measured under test conditions. Author

N65-31828# Varian Associates, Palo Alto, Calif. Central Research Lab.
SOLID STATE MICROWAVE AND POWER DEVICES. VOLUME 2: INTEGRATED AMPLIFIER Interim Technical Documentary Report No. 2
Herbert Kroemer Oct. 1963 29 p refs
(Contract AF 33(657)-11015)
(Rept.-307-2Q, Vol. 2; AD-463109)

The objective of the integrated amplifier project reported in this volume is to study solid-state amplifiers that utilize the negative resistance of tunnel diodes, as an amplifying mechanism, in combination with the non-reciprocity of the Hall effect in Hall-effect isolators, as a directionality-giving mechanism. If possible, it is intended eventually to build such "iso-tunnel" amplifiers wherein the constituent elements have been integrated into a single functional block. From a study of the temperature dependence of Hall isolators it is concluded that it is of utmost importance to find practical ways of either eliminating the drift of the isolator, or of compensating for it. The frequency dependence studies were essentially concluded with the realization that skin effect is harmful in that it reduces the effective Hall angle. A Hall-effect isolator bibliography was compiled. Author

N65-31843# Texas Instruments, Inc., Dallas.
GALLIUM ARSENIDE MICROWAVE TRANSISTORS Second Interim Engineering Report, 1 Nov. 1964–31 Jan. 1965
Melvin Belasco Wright-Patterson AFB, Ohio, AF Avionics Lab., Feb. 1965 49 p refs
(Contract AF 33(615)-2101)
(TI-08-65-23; AD-463708)

A new emitter formation technology was developed. Sulfur is diffused from the vapor phase into the emitter area, defined by SiO_2 films, to form the n-type emitter. A Au-Sb-Ni alloy is used to make a very low resistance ohmic contact to the emitter. Transistors made with this emitter have been probed. A minimum thickness has been established for the epitaxial layer used in the standard transistor process. Diffusion of sulfur from the epitaxial layer-substrate interface into the layer during the magnesium diffusion cycle was found to cause the bands seen in the epitaxial layer upon staining. The epitaxial deposition process was modified. A new feed temperature and substrate etch were found to reduce layer thickness gradients and to improve the quality of the surface. Additional transistors were built with evaporated, alloyed emitters to test changes in the standard process and provide units for characterization studies. A new collector contact alloy is being used to increase the upper temperature limit of the transistor to 300° C. Author

N65-31870# Westinghouse Electric Corp., Philadelphia, Pa.
PRODUCTION ENGINEERING MEASURE, TYPE 2N2762 SILICON ALLOY TRANSISTOR Quarterly Progress Report, 1 Jan.–31 Mar. 1965
T. E. Ebert, R. J. Pisarcik, and J. E. Priest [1965] 17 p
(Contract DA-36-039-AMC-03617(E))
(QPR-7; AD-617736)

All process improvements are reported as completed and incorporated in the manufacture of the contract device. Data are presented to demonstrate an increase of the energy level at which secondary breakdown occurs in the contract device when compared to devices fabricated using standard product techniques. A summary of progress and yield information is presented for the production run now in progress. Data for revised reliability test program are presented. Author

N65-31872# General Electric Co., Schenectady, N. Y. Research Lab.
RESEARCH ON CdTe
R. E. Halsted, D. T. F. Marple, and B. Segall 30 Apr. 1965 23 p refs
(Contract AF 33(616)-8264)
(QPR-15; AD-616606)

Research activities on CdTe are reported. Work status on the purification of CdTe and single crystal growth is described. Work was also done on establishing preparation conditions which yield p-type samples with transport characteristics dominated by shallow acceptor levels in reproducible concentrations. Preparation conditions responsible for particular band edge emission spectra were investigated. R.N.A.

N65-31885# Honeywell, Inc., Minneapolis, Minn. Aeronautical Div.
NON-DESTRUCTIVE RELIABILITY SCREENING OF ELECTRONIC PARTS, USING RF NOISE MEASUREMENTS Final Report, 19 Dec. 1963–19 Dec. 1964
H. Avil, C. Maronde, and L. Kirvida Griffiss AFB, N. Y., RADC, Jun. 1965 171 p refs
(Contract AF 30(602)-3258)
(RADC-TR-65-71; AD-618469)

The report describes an investigation and evaluation of radio frequency (RF) noise in silicon diodes and solid tantalum capacitors. The specific intent of this effort was to establish and validate RF noise measurements as a technique for selecting and rejecting from a production lot of electronic parts those parts with lifetimes less than the average lifetime of the production lot, thereby increasing average lifetime and time to first failure. Large quantities of diodes and capacitors were screened; results are categorized and tabulated in this report. In addition to the screening effort, rejected components were life-tested with a control sample of good components, and efforts were made to optimize the screening technique. Also failure mechanisms that cause generation of RF noise were investigated both theoretically and experimentally. Findings of these investigations, as well as results of life test and screening optimization, are also presented in this final report. Author

N65-31887# Clevite Corp., Palo Alto, Calif. Shockley Research Lab.
RESEARCH ON SOLID STATE NOISE DEVICES Final Report, 1 Aug. 1964–30 Jun. 1965
David Farrington Washington, HDL [1965] 58 p refs
(Contract DA-49-186-ORD-1086)
(AD-618496)

This report is concerned with an experimental investigation of a silicon noise diode having an avalance breakdown voltage of approximately 12 volts and capable of producing high amplitude white noise over the frequency range 40 kc to 220 kc. The influence of the device parameters on the performance of completed devices from many independent diffusions is examined. A study of the design of a noise generator with high pulse rate is presented. Author

N65-31893# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SEMICONDUCTOR THERMISTORS IN AUTOMATION
G. K. Nechayev 20 Apr. 1965 263 p refs Transl. into ENGLISH of the book "Poluprovodnikovyye Termosoprotivleniya v Avtomatike" Kiev, Izd. Tekhn. Lit. USSR, 1962 p 1–254
(FTD-MT-64-210; AD-466440)

In the book are described the physical properties and characteristics of semiconductor heat-dependent resistors–thermistors which are the compound elements of circuits of automatic devices. Methods are considered for the calculation of static and dynamic conditions in circuits with thermistors. Methods are expounded for the calculation of temperature compensators and stabilizers, bridge circuits of different purposes relay circuits and other circuits with thermistors used in devices of automation. Descriptions are given of several automatic devices with application of thermistors. The book is intended for scientists and engineers working in the area of automation, and also for students of power engineering in higher educational institutions. Author

N65-31897# Edgerton, Germeshausen and Grier, Inc., Bedford, Mass. Systems Div.
XLS-60 AND LS-53 OPTICAL BEACON SYSTEMS Final Report, Apr. 1965
A. L. Rotch and G. J. Lichtblau Apr. 1965 62 p
(Contract AF 19(628)-4049)
(B-3068; AFCRL-65-292; AD-464806)

The design and fabrication of a balloon-borne xenon optical beacon for laser and optical tracking and a missile-borne xenon optical beacon for optical tracking are documented. The basic elements of a xenon flashing light system are described. Design parameters and light output are determined for flat-plate reflectors and quasi-paraboloidal "tailoring" reflectors giving constant illumination at varying slant ranges. Electrical design parameters for xenon optical beacon space applications are specified and proved. Previous space flight successes are described. Author

N65-31899# Fairchild Semiconductor Corp., Mountain View, Calif.
X-BAND SOLID-STATE POWER SOURCE Third Quarterly Progress Report, 1 Dec. 1964–28 Feb. 1965
E. Guthrie, R. Henschke, R. Orrick, and D. Richardson Ft. Monmouth, N. J., Army Elec. Command, 1 Apr. 1965 50 p refs
(Contract DA-28-043-AMC-00120(E))
(Rept.-3; AD-465770)

A transistor oscillator driver circuit has been constructed that produces 1.25 watts from 1.06 to 1.13 Gc. Another prototype oscillator has been tested and produces 1.0 watt from 1.4 to 1.5 Gc. Test jigs for the corresponding frequency multipliers have been constructed. A couple of silicon varactor diodes have given 40% conversion efficiency in the quadrupler jig going from 1.1 Gc to 4.4 Gc. Also, 60% efficiency was achieved with a gallium arsenide diode in a doubler jig going from 4.4 Gc to 8.8 Gc. The sextupler jig is complete and several diodes are being evaluated. Author

N65-31934# Raytheon Co., Waltham, Mass. Microwave and Power Tube Div.
RESEARCH AND DEVELOPMENT OF A V-BAND 3.2 MILLIMETER MAGNETRON Final Report, 15 Aug. 1964–15 Feb. 1965
R. Plumridge [1965] 58 p
(Contract DA-28-043-AMC-00229(E))
(PT-913; AD-467252)

The study included the development and cold testing of X- and V-band models of the anode, and the design and testing of critical components of the tube such as the heater cathode assembly and the mode damper. A 9-scaled X-band cold test model of the anode, cavity and output was made and extensively investigated. The fast cyclotron mode interference problem was explored. A satisfactory V-band anode was made with E.D.M. techniques. A good unloaded Q was measured with the V-band anode and a satisfactory match was obtained with a $\lambda/2$ ceramic window. A practical magnetic circuit was worked out to provide high magnetic field. An investigation of carburized ceramic dampers was made and, although a satisfactory damper was not developed during this period, the design of a good damper does not appear to be a difficult problem. A model of the heater cathode assembly was constructed for bell jar test and was life tested for a period of 1040 hours. Author

N65-31940# Texas Instruments, Inc., Dallas.
MOLECULAR ELECTRONICS FOR RADAR APPLICATIONS Interim Engineering Report No. 2, 1 Jan.–31 Mar. 1965
Tom M. Hyltin and Gerard J. Kelly Apr. 1965 94 p
(Contract AF 33(615)-1993)
(TI-03-65-40; AD-467031)

Technical details of work performed in signal power generation, signal reception, high frequency signal processing, low frequency signal processing, and equipment engineering are presented. Relating to signal power generation, ceramic breadboards for single and multiple stage 2.25 Gc power amplifiers were designed; a power output of 1.7 W at 3.2 dB power gain at 2.25 Gc was achieved for a high-frequency high power transistor; and development was reported on a ceramic thin-film breadboard of an eight varactor frequency quadrupler, and surface-oriented silicon varactors for use in a frequency multiplier. Components considered in signal reception are: barrier diodes, a 500 Mc single-stage amplifier, and a single-sided transistor. A computer program and PIN switching diodes relating to high frequency signal processing, and an electronic circuit analysis program for evaluating low frequency signal processing are reported. Areas considered in equipment engineering are a five wire transmission line configuration; a study of signal distribution techniques; a package for evaluating microwave integrated circuits; and an antenna element study. C.T.C.

N65-31941# California Univ., Berkeley. Electronics Research Lab.
STUDY OF A FOCUSED, DECELERATING CROSSED-FIELD ELECTRON STREAM
J. Christensen 28 Aug. 1964 82 p refs
(Contract DA-36-039-AMC-02164(E))
(Rept.-64-32; AD-461317)

An experimental crossed-field tube designed to produce a focused, decelerating beam is described. The electrode configuration is a symmetrical, accelerating-decelerating system utilizing short Kino electron guns for the gun and collector sections of the tube. The design of the electrodes, based on an infinite planar magnetron diode flow, is presented. A computer analysis of the flow in the experimental tube is presented. The results of the analysis show that the flow produced by the electrode configuration is not that predicted by the design theory. The resulting flow was asymmetric, nonlaminar, and poorly focused in the collector region of the tube. This is verified by observations of the experimental flow. It is concluded that this is the reason for the incomplete collection of the beam. Several experiments were performed to discover if instabilities were present in the beam. From the results of these experiments, it is concluded that no instabilities are present in the beam, and that a properly focused beam could be collected at zero potential. Author

N65-31981# Raytheon Co., Wayland, Mass. Equipment Div.
TRAVELING IMAGE STORAGE TUBE (TRIST) Final Report of the Motion Assembly
Jan. 1965 53 p

Design, fabrication, and testing of the motion assembly of a traveling image storage tube are reported. These activities are part of a program to develop a display device which permits continuous real time observation of data acquired from line scan systems. Specific topics reported are motion assembly design, scroll drive methods, harmonic drive, selection of various bearings and lubricants, motion assembly operating tests and subsequent modifications, and a brief account of the program status at the contract termination. J.M.D.

N65-31994# Radio Corp. of America, Camden, N. J.
A STUDY OF LOW-OUTPUT-VOLTAGE CONVERSION AND REGULATION TECHNIQUES Final Report
R. Kisko and W. Needs Griffiss AFB, N. Y., RADC, Jun. 1965 71 p refs
(Contract AF 30(602)-3518)
(CR-65-595-1; RADC-TR-65-126; AD-618470)

This report describes the results of a study conducted to determine the state of the art of DC bias power supplies with high regulation and fractional output voltages. The availability of fractional-output-voltage power supplies was determined by a survey of literature and a canvass of power supply manufacturers. This effort revealed that none was available. A study was then undertaken to determine the feasibility of producing such devices with high output current and high efficiency. Three methods were studied: the transistor-rectifier technique, the transformed-diode technique, and the use of unconventional generators based on the Hall effect. The results indicate that the first method is completely feasible, the second is completely infeasible, and the third has potential, but requires further investigation. Author

N65-31997# Radio Corp. of America, Camden, N. J.
OSCILLATORS SENSING TECHNIQUES Final Technical Documentary Report, Jan. 1963–Sep. 1964
Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., May 1965 79 p refs
(Contract AF 33(657)-10564)
(FDL-TDR-64-150; AD-617520)

This report describes the technical findings of a research and development effort to determine the feasibility of using the oscillistor, a molecular electronics device, to sense changes in voltage, temperature, and angular position. Both germanium and silicon oscillistors were fabricated and evaluated for the sensing application. The theory of oscillistor operation was summarized and compared with actual device performance data. Test models were fabricated. Silicon oscillistors were found to be the most stable. It is recommended that advances in silicon planar technology be applied to produce a silicon oscillistor with lower operating impedance. Such a device would make a practical low-dissipation sensor. Author

N65-31999# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTAL DETERMINATION OF PARAMETERS OF THE LAW GOVERNING DISTRIBUTION OF TIME PROBABILITIES BY PRECISE OPERATION OF AN ELECTRONIC APPARATUS
L. P. Leont'yev 24 May 1965 16 p refs Transl. into ENGLISH from Avtomatika i Vychislitel'naya Tekhn. (USSR), v. 3, 1962 p 133–142
(FTD-TT-65-56/1+2; AD-617672)

Parameters of the law governing distribution of time probabilities are determined from a statistical treatment of tabulated operational failure data for radioelectronic equipment. The possibility of quantitatively evaluating the reliability of the apparatus during its entire period of operation was shown. L.S.

N65-32000*# General Electric Co., Schenectady, N. Y. Microwave Tube Business Section.
DEVELOPMENT OF HIGH-TEMPERATURE, GAS-FILLED, CERAMIC RECTIFIERS, THYRATRONS, AND VOLTAGE-REFERENCE TUBES Quarterly Progress Report No. 2, 15 Mar.–14 Jun. 1965
E. A. Baum [1965] 29 p
(Contract NAS3-6469)
(NASA-CR-54478) CFSTI: HC $2.00/MF $0.50 CSCL 09A

Progress is reported on the program to establish the validity of high-temperature tube technology and design concepts. Five ceramic thyratrons were fabricated. The first thyratron was tested for three hours at 600° to 650° C when a leak developed in the brazed joint between the exhaust tabulation and the anode assembly. During this period, the tube was operated at 10 A current at 60 cycles. A second thyratron of the same design configuration was tested for 80 hours at temperatures above 600° C; approximately 10 to 15 hours of the total test time was at 3000 cycles. The tube was still operable after this period of time but was removed from the test station to allow for the testing of tube number three. Subsequent tests were made at 15 A average current and 175 volts peak inverse from 400 cycles to 3000 cycles. A finned-cathode structure was designed so that the cathode heater is external to the tube. This cathode has an area of 70 square centimeters as compared to the 25-square-centimeter cathode presently in use. The average current capacity of the larger cathode is in excess of 15 A. E.E.B.

N65-32017# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
SYNCHRO TO DC CONVERTER
R. G. Mischler 21 Apr. 1964 17 p refs
(FIN-2-298)

Progress is reported on the development of a synchro-to-direct current converter. The development effort has resulted in a breadboard version of a converter which largely avoids the problems associated with the transistorized phase-to-analog converter. Although extensive harmonic distortion and temperature tests have not been made, it is considered that inherently this circuit will be relatively insensitive to harmonic distortion and can be designed to operate satisfactorily over the temperature range expected for shipboard use. Nonlinearity is less than ±0.5% deviation from best straight line at 400 cps and 115 volts. Drift in converter output is 0.37% maximum over the frequency range 380 to 420 cps. The converter exhibits zones of ambiguity at 0° and 180°. Each of these zones is less than 0.8° wide. The circuit has been operating satisfactorily for several months with no component failure. E.E.B.

N65-32021# Los Alamos Scientific Lab., N. Mex.
THE DEVELOPMENT OF AN INTERLEAVED, FRACTIONAL-TURN COIL
Robert S. Dike, Edwin L. Kemp, and John Marshall 1 Aug. 1965 7 p refs
(Contract W-7405-ENG-36)
(LA-3234) CFSTI: $1.00

An interleaved, fractional-turn coil design is explained, and the current flow in the coil is discussed. A quarter-turn, 9-in. i.d., 11 in. long coil was built and connected to four 25 kV banks with a combined energy of 25 kJ. The system produced 63-kV theta voltage around the coil and generated 13 kG rising in 1.6 μsec. This coil is shown, and the mechanical and electrical advantages are discussed. Author

N65-32050# General Precision, Inc., Little Falls, N. J. Kearfott Div.
INVESTIGATION OF AN ELECTROLUMINESCENT SYMBOLIC INDICATOR Final Report, 29 Jan. 1964–29 Jan. 1965
Donald Levy and A. Russo Griffiss AFB, N. Y., RADC, Jun. 1965 83 p
(Contract AF 30(603)-3316)
(RADC-TR-65-103; AD-618300)

This report describes the results of a study, design and breadboard construction of a segmented Electroluminescent (EL) Symbolic Indicator. The equipment accepts a parallel 6-bit binary-coded input and converts the data into a symbolic readout on a 23-segment EL panel in response to an ADDRESS command pulse. Display capabilities include all the alpha-numerics, minus sign, plus sign and left and right slant bars. Data storage is implemented at the 23 segment-switching command lines so that a single code converter may be time-shared among many output display modules. The breadboard model of the EL Symbolic Indicator consists of two modules: an output display module and a multiplexed code converter. The size of the 23-segment readout format is 1 1/8 × 1 5/8 inches. Packaging of the lamp assembly and output display module is such that large arrays may be assembled with a separation between adjacent lamps of two stroke-widths. Author

N65-32052# Army Electronics Labs., Fort Monmouth, N. J.
DEVELOPMENT OF ELECTROSTATICALLY FOCUSED SUPPORTED-DRIFT-TUBE KLYSTRON OSCILLATORS
Arthur Wachtenheim, John J. Tancredi, and Arthur Gottfried Apr. 1965 24 p refs
(ECOM-2584; AD-617917)

This report describes the design of 10-milliwatt and one-watt X-band, supported-drift-tube klystron oscillators. Technological construction problems and their solutions are also discussed. A number of beam testers were constructed to investigate beam transmission problems. Because of the poor beam transmission, no operable klystrons were built. The beam transmission problem will have to be solved before successful tubes can be fabricated. Author

N65-32062# Melabs, Palo Alto, Calif.
INVESTIGATION OF MICROWAVE NON-LINEAR EFFECTS UTILIZING FERROMAGNETIC MATERIALS Final Report, 17 Mar. 1962–16 Feb. 1965
Lee F. Donaghey and Roy W. Roberts, Jr. [1965] 94 p refs
(Contract DA-36-039-SC-89206)
(AD-618915)

Non-linear effects in the microwave properties of ferrites and ferromagnetic garnet materials were investigated with emphasis on determining the feasibility of and parameters for low noise ferrite parametric amplification. Ferrite parametric amplification was demonstrated in K_u band with yttrium iron garnet (YIG). An analysis was derived which allows comparison between the ferrite amplifier and the diode amplifier. In theory, both amplifiers have similar threshold pump powers. Diode Q's are lower than YIG Q's. Diode Q's decrease with increasing frequency while YIG Q's increase or remain constant. However, the diodes have a much larger non-linear coupling term which remains constant with increasing frequency, whereas it decreases for the ferrite. Experimental measurements have not yielded threshold pump powers for YIG as low as theory indicates. Magnetodynamic mode operation is demonstrated as a useful operation method of the ferrite amplifier with advantages and disadvantages of both the electromagnetic and magnetostatic modes of operation. Magnetodynamic operation is broken into three types depending on signal and idler mode positions relative to the Walker magnetostatic spectrum. R.N.A.

N65-32073# Silicon Transistor Corp., Garden City, N. Y.
PRODUCTION ENGINEERING MEASURE TO INCREASE THE RELIABILITY OF THE TRANSISTOR TYPE 2N2034 VOLUME I: PROCESS IMPROVEMENTS Final Engineering Report, 22 Jun. 1963–15 Mar. 1965
G. J. Chesnes, F. Des Roches, D. Hughes, and A. Palmeri [1965] 139 p
(Contract DA-36-039-AMC-01482(E))
(AD-618726)

The process improvement program for the silicon transistor was completed. The work performed is discussed; production results are reported; and the reliability test program

is described. The operating life test data indicated that the reliability goals have been achieved. Process specifications and quality assurance procedures are included. E.E.B.

N65-32079*# Stanford Research Inst., Menlo Park, Calif.
RESEARCH ON RELIABLE AND RADIATION INSENSITIVE PULSE-DRIVE SOURCES FOR ALL-MAGNETIC LOGIC SYSTEMS Final Report
J. A. Baer and C. H. Heckler, Jr. Jun. 1962 56 p refs Prepared for JPL
(Contracts NASw-6; JPL-950104)
(NASA-CR-64442) CFSTI: HC $3.00/MF $0.50 CSCL 09A

The minimization and elimination of electron tube and semiconductor devices in a pulse generator for spacecraft applications are considered. Such a pulse generator should be suitable for use as the source of pulse power for digital magnetic equipment. Potential means of suitable pulse generation are discussed, feasibility is demonstrated in some cases, and requirements for further investigation are indicated in others. A successful pulse generator was developed and applied to driving a large number of digital magnetic circuits. The method which has previously been used in radar applications takes an alternating current input and shapes it into a series of current pulses suitable for driving magnetic circuits. Also, a class of devices known as interrupters was reexamined. These interrupters are a type of inverter which can convert direct current into unipolar pulses suitable for driving magnetic circuits. E.E.B.

N65-32081*# Lockheed-Georgia Co., Marietta. Georgia Nuclear Labs.
COMPONENTS IRRADIATION TEST NO. 13: 2N2501 TRANSISTORS, TI 551 DIODES AND VARIOUS TYPES OF THERMISTORS
Apr. 1965 68 p
(Contract NAS8-5332)
(NASA-CR-64433; ER-7899) CFSTI: HC $3.00/MF $0.75 CSCL 09A

Continued tests designed to determine the effects of radiation on electronic equipment, circuits, and components contemplated for use on a nuclear space vehicle, are reported. Presented are results of tests on a transistor and a diode, which were subjected to a nuclear radiation environment at 30° C; and several thermistors which were subjected to the same radiation environment at 0° C. Measurements were made to determine the effect of radiation on the h_{FE}, h_{ie}, and I_{CBO} parameters of the transistors; the V_F and I_R parameters of the diodes, and the resistance (temperature indication) of the thermistors. Test data for the transistor indicated that: all specimens failed (50% decrease in h_{FE}), normalized h_{ie} decreased at a slightly greater rate than did normalized h_{FE}, and I_{CBO} was increased by the irradiation. Diode test data indicated that: both V_F and I_R were increased by the irradiation, no specimen showed an increase in V_F as great as 100%, and all specimens failed bacause of increase in I_R. Only one group of thermistors contained specimens which all showed permanent radiation effect. S.C.W.

N65-32101# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy).
MEASUREMENT OF VOLTAGE TO RADIOFREQUENCIES WITHIN A CAVITY RESONATOR [MISURA DELLA TENSIONE A RADIOFREQUENZA ENTRO UN RISUONATORE A CAVITA]
D. Fabiani and M. Puglisi 25 Jun. 1965 28 p refs In ITALIAN *Its* Nota Interna No. 281
(LNF-65/20)

An indirect experimental determination of the maximum energy required for a certain type of cavity resonator to transmit a charged particle beam in terms of the focusing and equivalent resistance of the resonator is presented. After a brief review of the often used spring gauge system, a method for the transformation of the current is examined. Calibration methods are presented which give easily reproducible results. An alternate electrostatic device for calibration is also described which gives the required precision. Results obtained by the method prescribed have not previously been obtained. Transl. by G.A.L.

N65-32108# Bendix Corp., Southfield, Mich. Research Labs. Div.
EXPLORATORY DEVELOPMENT OF THE Q-FACTOR TECHNIQUE Fifth Quarterly Progress Letter, Period Ending Jun. 30, 1965
Max Frank 13 Jul. 1965 18 p refs
(Contract AF 29(601)-6316)
(Rept.-3034; AD-618194)

Data for predicting transistor gain degradation in a neutron radiation environment were obtained from experimental studies of the variation of the radiation damage constant K_γ as a function of temperature and current during both measurement and irradiation. Relatively small spreads in the values of K_γ were obtained when the individual base transit times were measured and the radiation exposures were precisely determined. Radiation damage effect data from 20 different n-p-n silicon transistor types were obtained and normalized to the same minority carrier concentration in the base region, using the transit time and the V_{BE}-I_c characteristics of the specific transistors. The resulting relative dispersions of the damage constant for minority carrier densities of $10^{15}/cm^3$ and $10^{16}/cm^3$ were typically 15 to 20 percent. Author

N65-32140# Thermo Electron Engineering Corp., Waltham, Mass.
OPTIMUM EMITTER CAVITIES FOR THERMIONIC ENERGY CONVERTERS Quarterly Status Report No. 3, 1 Feb.–30 Apr. 1965
F. Rufeh, S. S. Kitrilakis, and D. Lieb [1965] 37 p refs
(Contract AF 19(628)-4322)
(TE-82-65)

To determine the diffusion coefficient, a modified version of a pulse experiment was conducted which employed the three-collector diode technique. The ion generation rate in collector C_1 was increased by an instantaneous voltage signal, while collector C_3 monitored the build-up of the diffused ions, giving the diffusion coefficient. Theoretical analysis of this experiment for a step-function ion source is presented. The experimental procedures are described, and the schematics of the system are shown. The time constants that were derived from the experimental data showed the functional dependence on interelectrode spacing that was predicted. The diffusion coefficient of cesium ions in cesium vapor was found to be 43 cm^2/sec at the pressure of 1 torr and an average gas temperature of 823° K. The diffusion coefficient was inversely proportional to the pressure at constant gas temperature. The recombination probability of the ions in the interelectrode space was found to be negligible compared with the leakage probability of the ions through the boundaries of the diode geometry. R.W.H.

N65-32197*# Honeywell, Inc., Minneapolis, Minn. Aeronautical Div.
GG 159 MINIATURE INTEGRATING GYRO STERILIZATION EXPOSURE STUDIES AT 300°F Final Report

John K. Sarkinen 10 Jun. 1965 53 p Prepared for JPL *Its* Rept.-20023-FRI
(Contracts NAS7-100; JPL-950769)
(NASA-CR-64451) CFSTI: HC $3.00/MF $0.50 CSCL 09A

Under development is a gyro that will withstand sterilization cycling. The gyro was vibrated and the anisoelastic coefficient was determined during the initial tests, after the first and fifth sterilization cycle. The attitude angle coefficient was determined during the initial test. The g-sensitive and non-g-sensitive torques were determined initially and after each sterilization cycle. The torque shifts during sterilization cycling were not excessive except for the first cycle. Although it is normal for a gyro to shift during the first temperature cycling after final build, this shift could be eliminated by an initial temperature cycle before trimming and proceeding to the sterilization cycling. The spinmotor testing at room temperature synchronized with 42 to 48 volts. The voltage was reduced to 36 volts per phase, and the spinmotor continued to run at the synchronous speed. R.W.H.

N65-32205# Library of Congress, Washington, D. C. Aerospace Technology Div.
SOVIET AIRCRAFT CIRCUIT BREAKERS, ANNOTATED BIBLIOGRAPHY Surveys of Soviet-Bloc Scientific and Technical Literature
22 Jul. 1965 25 p refs
(ATD-B-65-54; AD-618471)

An annotated bibliography is presented on Soviet aircraft circuit breakers. Articles dealing with relays and contactors, which are used alone or in combination to perform circuit breaker operations, and devices such as generator control boxes and storage battery switching boxes, which are used as components with circuit breakers, are included. Available technical characteristics of the contractors, thermal circuit breakers, relays, and control boxes cited in the bibliography are tabulated in the appendix. R.N.A.

N65-32211# National Co., Inc., Melrose, Mass.
STUDY AND INVESTIGATION OF A PROTON MASER ANTENNA Final Report
Alexander Ganssen, Earl Law Sloan, III, Jonathan C. Webster, and Wayne Ledder Griffiss AFB, N. Y., RADC, Apr. 1965 134 p
(Contract AF 30(602)-2908)
(RADC-TR-64-567; AD-619043)

A new concept in a low frequency magnetic field sensor (the proton maser antenna) is presented. The basic theory of the Promant operation is explored and calculations are given for the threshold sensitivity in terms of the system parameters. A breadboard model Promant has been constructed to verify the predicted operational behavior. A description of the model and procedures of its application in testing the basic theory are presented in detail. An investigation of several different free radical solutions is reported. The response of the Promant was studied in the frequency range from dc to 1000 c/s. The present research effort has shown that Promant is an extremely sensitive low frequency magnetic field sensor. The breadboard model represents only an initial approach to the problem. Means to improve the sensitivity by perhaps as much as 70 dB and to preserve a constant threshold response to high frequency are proposed. Author

N65-32229# Michigan Univ., Ann Arbor.
INVESTIGATION OF LARGE-SIGNAL KLYSTRON AND TRAVELING-WAVE DEVICES Quarterly Progress Report No. 2, 1 Dec. 1964–28 Feb. 1965
G. T. Konrad, J. E. Rowe et al Griffiss AFB, N. Y., RADC, Jun. 1965 63 p refs
(Contract AF 30(602)-3569)
(RADC-TR-65-151; AD-618916)

Solutions obtained from the digital computer on nonlinear interaction equations for Brillouin focused linear-beam devices are described. It is possible to handle both uniform as well as varying axial magnetic fields. Harmonic current amplitudes are shown for the former case. The specification of initial and boundary conditions on the nonlinear boundary-value solution for electron and plasma devices presented some difficulties. Methods for overcoming these problems are shown. Simplifying assumptions in the stability problem of beams in the presence of large r-f signals are described. The phase velocity taper for a ring-and-bar tube has been chosen. The impedance variation and velocity profiles for this circuit are shown. Some saturation data for the untapered tube is presented. Results obtained from a relativistic electron gun program are described. A highly convergent gun with a converging magnetic field was used in the case considered to date. Author

N65-32230# Cutler-Hammer, Inc., Deer Park, N. Y. Airborne Instruments Lab.
MILLIMETER AND SUBMILLIMETER COMPONENT DEVELOPMENT Fourth Quarterly Report, Dec. 1964–Feb. 1965
J. J. Taub, J. Cohen, H. J. Hindin, G. Kurpis, F. A. Arams et al Griffis AFB, N. Y., RADC, Jul. 1965 53 p refs
(Contract AF 30(602)-3343)
(RADC-TR-65-163; AD-618917)

Techniques for the design of filters, ferrite devices, diode mounts, and radiation detectors in oversize waveguide are being investigated. Theoretical and experimental results are described in this report. Single-resonator and double-resonator grating filters were investigated at 300 Gc. Also investigated were designs for broadening the stop-band region of the dielectric slab filters. Work has continued on Faraday rotation in oversize waveguide. The isolator structure has been redesigned. Tangential sensitivity measurements were made of the diode waveguide detectors to compare the standard and oversize mounts. These results are presented. Additional envelope detection and superheterodyne mixer experiments using bulk semiconductors were performed and improved performance was obtained using optimized InSb material. A conversion loss approaching 9 db has been obtained. Author

N65-32235# Cutler-Hammer, Inc., Deer Park, N. Y. Airborne Instruments Lab.
MILLIMETER AND SUBMILLIMETER COMPONENT DEVELOPMENT Third Quarterly Report, Sep.–Nov. 1964
J. Taub, J. Cohen, J. Hindin, G. Kurpis, F. Arams et al Griffiss AFB, N. Y., RADC, Jun. 1965 56 p refs
(Contract AF 30(602)-3343)
(RADC-TR-65-21; AD-618402)

Techniques for design of filters, ferrite devices, mounts, and radiation detectors in oversize waveguide are being investigated. Theoretical and experimental results are presented in this report. The 2 and 0.9 mm regions of the dielectric slab filters were evaluated. In addition, the effect of small-waveguide dissipation on the dielectric slab filters was derived. Experiments have continued on Faraday rotation in oversize waveguide. First measurements have been made at 1 mm. An isolator has been constructed. No work has been performed on diode mounts in this quarter. Work will resume during the fourth quarter. A new type of millimeter–submillimeter mixer using bulk semiconductor was analyzed and successfully demonstrated. The analysis was checked using a low-frequency prototype consisting of a bolometric mixer operating at 1 Mc. Millimeter mixing was obtained in the 30 to 40 Gc region using bulk n-type indium antimonide as the mixer element. A conversion loss of 24.5 db was measured using nonoptimum material. When corrected for mismatch losses and other effects, a conversion loss of 15.5 db is calculated. Author

N65-32236# Hughes Aircraft Co., Newport Beach, Calif. Microelectronics Div.

SEMICONDUCTOR DESIGN EFFECTS ON RADIATION RESISTANCE Quarterly Report, 15 Dec. 1964–15 Mar. 1965

[1965] 63 p refs

(Contract DA-28-043-AMC-00418(E))

(QR-1; AD-618078)

During the first quarter all the standard 2N708 transistors and all of the special transistors, except the PNP transistors, were fabricated. These special devices, incorporating a total of fourteen surface variations, were organized under the following general categories: 1. Surface damage. 2. Epitaxial layers. 3. Thermal oxide layers. 4. Pyrolytic oxide layers. 5. Surface potential changes. The test circuit used with the Hughes Linac for measuring the radiation response was designed to limit to a minimum the interference from electromagnetic noise and the circuit time constant and still provide siffucient signal strength. Irradiation data included in this report were obtained on a total of six surface variations with the experimental error (as indicated by root-mean square deviations) less than 3%. Author

N65-32238# Northrop Corp., Newbury Park, Calif. Ventura Div.

STUDY FOR GENERALIZED MODEL FOR SEMICONDUCTOR RADIATION RESPONSE PREDICTION First Quarterly Progress Report, 15 Dec. 1964–15 Mar. 1965

James P. Raymond and William W. Chang Ft. Monmouth, N. J., Army Electron. Res. and Develop. Lab., [1965] 159 p refs

(Contract DA-28-043-AMC-00423(E))

(ECOM-00423-1; AD-618079)

The lumped-model technique was applied to the characterization of the radiation-induced transient response observed in diodes and transistors. This technique appears to be an effective and accurate method of representing device behavior. The results of the diode analysis shows that the two-lump model representation compares closely to the solution of the one-dimensional partial differential equations. In the case of the transistor behavior, it is almost certain that second-order nonlinearities will influence the results. After a careful review of the technique and application to the problems of determining the ionizing radiation effects in an ideal grown-junction diode and a grown-junction transistor, the lumped-model representation compares favorably with the more rigorous theoretical solutions of device behavior. This technique will provide a method of determining the behavior of the device in a straightforward manner, and can be used to define the critical device parameters and experiments for measuring them. R.W.H.

N65-32290# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

MICROMINIATURIZATION OF ELECTRONIC DEVICES AND PROBLEMS OF CHEMISTRY

F. A. Kuznetsov 16 Jul. 1965 15 p Transl. into ENGLISH from Vestn. Akad. Nauk SSSR (Moscow), no. 6, 1964 p 51–57

(FTD-TT-65-864/1+2+4; AD-618631)

The chemical side of the problem of microminiaturization of electronic devices is one of the promising aspects of work at the Institute of Nonorganic Chemistry, theories of chemical structures and crystal chemistry of inorganic substances, methods and means of obtaining high-purity substances, complex compounds and their utilization in new techniques forming the basic trends of study. Author

N65-32294# City Coll. of the City of New York. Research Foundation.

ELECTROSTATIC FOCUSING OF HOLLOW SPIRALING ELECTRON BEAMS First Quarterly Report, 5 Jan.–5 Apr. 1965

Morris Ettenberg [1965] 34 p

(Contract DA-28-043-AMC-00466(E))

(Rept.-1; AD-618218)

The conditions for a stable orbit under electrostatic focusing are derived for a coaxial geometry with tangential injection. Small deviations in injection velocity and direction are then considered and the trajectories are found to be stable against small perturbations. A simplified model of a spiral injection scheme is analyzed and found to offer the possibility of proper injection. Computer programs have been prepared to calculate trajectories for a wider range of input parameters and to calculate the potential in the spiral geometry injection scheme. A design for an experimental spiral gun has been prepared. Author

N65-32305# General Electric Co., Schenectady, N. Y. Research Lab.

NEW SOLID-STATE DEVICE CONCEPTS Scientific Report No. 1, Period Ending Mar. 31, 1965

M. Aven, R. O. Carlson, R. J. Ehle, R. N. Hall, and H. H. Woodbury Apr. 1965 36 p refs *Its* Rept.-65-GC-0304G

(Contract AF 19(628)-4976)

(AFCRL-65-296; AD-616350)

The solubility of Ag in CdS has been measured between 375° and 900° C and the results are interpreted to indicate at least two and probably three different forms of Ag in CdS. The profiles are discussed in terms of three independent steps in the incorporation of Ag in CdS. Optical absorption of $ZnSe_xTe_{1-x}$ crystals in the band edge region and their emission characteristics under photoluminescent and electroluminescent excitation have been examined. Considerable broadening of the band edge properties has been observed in both absorption and emission for the composition range of $0.09 < x \leq 0.90$. P-n junctions fabricated from $ZnSe_{0.36}Te_{0.64}$ crystals have shown external quantum efficiencies of 2.4% with the major peak of the electroluminescence spectrum at 2.0 ev. The internal reflectivities and electrical properties of Ag, Cu, Au, Al, Rh, and Ni films deposited by evaporation upon single crystals of GaAs have been studied. Al, Ag, Au, and Cu have high reflectivities as deposited, but only the first two remain high after heating to 430° C. Author

N65-32309# TRG, Inc., Melville, N. Y.

DEVELOPMENT OF A LOW-NOISE MILLIMETER-WAVE PARAMETRIC AMPLIFIER Quarterly Progress Report, 1 Jan.–31 Mar. 1965

B. Albrecht, J. Kliphuis, and D. Neuf Jul. 1965 17 p refs

(Contract DA-36-039-AMC-02365(E))

(Rept.-7; AD-618412)

A gain of 20 db and a bandwidth of 50 Mc was obtained at 30 Gc from a scale model of the 94 Gc amplifier. Measurements performed at 90 Gc on the latest group of diodes received from USAECOM (designated Lot S-80B) indicate that their cut-off frequency at zero bias is greater than 300 Gc. Selected diodes from this group have been pumped at 120 Gc and appear suitable for use in the 90-Gc amplifier. Author

N65-32391# Sperry Rand Corp., Gainesville, Fla. Electronic Tube Div.

ON THE MINIMUM FEASIBLE BEAM DIAMETERS GENERATED BY SHIELDED PIERCE GUNS

A. D. Sutherland [1965] 27 p refs

(NJ-2761-0105)

Minimum feasible radius for electron beams generated by shielded Pierce guns is deduced. Several design curves for rapid determination of this important tube design parameter are presented. It is shown that *high perveance, high area convergence* guns are desirable for millimeter wave applications. Contrary to a widespread concept, it is shown that for

constant beam power, low voltage operation, rather than high voltage operation, leads to smaller beam radii. Beam radii smaller than the order of 1/10 millimeter do not appear feasible with shielded Pierce guns. Author

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N65-31267 National Aeronautics and Space Administration, Washington, D. C.
NASA SPACE ELECTRONICS RESEARCH
G. A. Vacca *In* Arg. Natl. Comm. on Space Res. Interam. Symp. on Space Res., Proc., Vol. 1 1965 27 p (See N65-31263 20-30)

Current research in space electronics is discussed. Developments in guidance and control systems, communications techniques, data handling and processing, computers, instrumentation, and biosensors are reviewed, and applications of microelectronics, lasers, and other new techniques are identified within these developments. R.N.A.

N65-31285 Joint Publications Research Service, Washington, D. C.
ELECTRON BEAM EXCITATION OF MAGNETOSTATIC OSCILLATIONS IN MAGNETIZED FERRITE
L. A. Shishkin *In its* Izv. VUZov: Radiofiz., Vol. VIII, No. 2, 1965 10 Aug. 1965 p 107–114 refs (See N65-31275 20-23) CFSTI: $6.00

The author investigates the possibility of exciting magnetostatic oscillations in a magnetized ferrite specimen by means of an electron beam. The buildup coefficient is found. Author

N65-31286 Joint Publications Research Service, Washington, D. C.
THE EFFECT OF A WEAK HIGH-FREQUENCY FIELD ON AN ELECTRON CURRENT CREATING A VIRTUAL CATHODE
S. D. Gvozdover *In its* Izv. VUZov: Radiofiz., Vol. VIII, No. 2, 1965 10 Aug. 1965 p 115–128 refs (See N65-31275 20-23) CFSTI: $6.00

The dynamic regime of a virtual cathode is investigated. Formulas are obtained showing how a weak alternating field affects the constant current in the circuit of the collecting electrode. The sign of this current change depends on the ratio of the cathode current to the current applied to the collecting electrode in the static regime. The regions of the parameters are established for positive and negative current fluctuations. Author

N65-31288 Joint Publications Research Service, Washington, D. C.
A CASE OF GENERATION OF PERIODIC MOTIONS
Yu. I. Neymark and L. P. Shil'nikov *In its* Izv. VUZov: Radiofiz., Vol. VIII, No. 2, 1965 10 Aug. 1965 p 141–153 refs (See N65-31275 20-23) CFSTI: $6.00

The authors consider the problem of the generation of periodic motions from a trajectory passing from saddle to saddle in the case of a dynamic system of the piecewise-linear type. Author

N65-31290 Joint Publications Research Service, Washington, D. C.
THE OPERATION OF A PARAMETRON EXCITED BY AN EXTERNAL CURRENT
L. A. Sinitskiy *In its* Izv. VUZov: Radiofiz., Vol. VIII, No. 2, 1965 10 Aug. 1965 p 164–175 refs (See N65-31275 20-23) CFSTI: $6.00

Processes which occur in an induction parametron with an ideal magentization curve of the cores and a square-wave excitation current are considered. A stable regime of subharmonic oscillations in which the cores are successively saturated is shown to exist, but simultaneous saturation of both cores is found to be impossible. The field strengths in the cores are given, certain dimensionless variables and parameters are introduced, and equations for upper and lower region phase trajectories are included. The periodic process in which there is motion along the phase trajectory and the stability of periodic modes are considered. It is established that the duration of the transition process in a parametron is large in comparison to the period of the exciting voltage. While the modes considered do not exhaust all the possible periodic processes, it is concluded that the existence of subharmonic oscillations of an arbitrarily high order is possible in principle. M.W.R.

N65-31291 Joint Publications Research Service, Washington, D. C.
THE DYNAMICS OF AN OSCILLATOR–ROTATOR SYSTEM
V. M. Bol'shakov, Ye. S. Zel'din, R. M. Mints, and N. A. Fufayev *In its* Izv. VUZov: Radiofiz., Vol. VIII, No. 2, 1965 10 Aug. 1965 p 176–193 refs (See N65-31275 20-23) CFSTI: $6.00

Motion resulting from rotation of an unbalanced rotor of an electric motor attached to an elastic beam is studied by the small parameter method. Considered is the case in which angular velocity of rotation of the armature is close to the cyclic frequency of the free vertical oscillation of the motor and the beam. Topological structure of the partition of a plane is studied and physical parameter space is partitioned into areas of different qualitative behavior of the oscillator–rotator system. An equation of motion for the system is developed, shortened van der Pol equations are investigated qualitatively, and the number and nature of equilibrium states is considered. The results are then evaluated and compared with experiments. M.W.R.

N65-31292 Joint Publications Research Service, Washington, D. C.
MULTIPLE MODES IN A FREQUENCY DIVIDER WITH TWO NONLINEAR ELEMENTS
M. A. Rakov and Yu. M. Shumkov *In its* Izv. VUZov: Radiofiz., Vol. VIII, No. 2, 1965 10 Aug. 1965 p 194–205 refs (See N65-31275 20-23) CFSTI: $6.00

A theoretical investigation is made of modes of four-fold and six-fold frequency division in a magnetic frequency divider with a diode in the excitation winding circuit. A fitting-type method, using a dynamic demagnetization curve, compares theoretical and experimental data. Equations are included for determining the values of the inductions as well as the angles of commutation and the constant voltages. It is emphasized that the system of equations is quite complex and is best solved with computer aid. Confirmed are earlier conclusions that the data of the 1:2 mode calculated for the same parameter values are suitable for determining the amplitude of the voltage across the capacitance in multiple modes. The resultant error does not exceed 10%. The purity of the modes considered and the widths of the regions of stable division are considered the most important experimental results. M.W.R.

N65-31293 Joint Publications Research Service, Washington, D. C.
ANALYSIS OF AUTOMATIC CONTROL SYSTEMS CONTAINING A MODULATOR AND HALF-WAVE DEMODULATOR
V. I. Gostev *In its* Izv. VUZov: Radiofiz., Vol. VIII, No. 2, 1965 10 Aug. 1965 p 206–221 refs (See N65-31275 20-23) CFSTI: $6.00

Transfer function was determined for a modulated automatic control system with an information channel at the carrier frequency consisting of a modulator, inertia-free amplifier, and demodulator. The system was analyzed as a linear amplitude pulse system by the discrete Laplace transform method. Formulas were developed and examples of analysis and calculations are included. The effect of the modulator-half wave demodulator circuit, the presence of which may affect the dynamics of the system or lead to instability, is revealed through a relatively simple analysis. Diagrams are included for the automatic system as well as a pulse system equivalent and a slave system. M.W.R.

N65-31301 Joint Publications Research Service, Washington, D. C.
EXPERIMENTAL INVESTIGATION OF ELECTRON MOTION IN A GENERATING MAGNETRON
L. M. Groshkov and V. Ye. Nechayev *In its* Izv. VUZov: Radiofiz., Vol. VIII No. 2, 1965 10 Aug. 1965 p 261–266 refs (See N65-31275 20-23) CFSTI: $6.00

The longitudinal probe method is used to observe motion of electrons in the precathode region of a multi-resonator magnetron. The thin beam of electrons injected into the interelectrode space at different phases sometimes results in a blurred image on the fluorescent screen of the tube. Trajectories are of loop form for voltages below threshold values; the electron beam track is a small arc when power coherent oscillations appear, and the arc increases with power oscillation increase. It was shown that the numerical models which operate by analytical methods and in which initial movement of electrons is along perturbed epicycloidal trajectories are the models which come closest to being realized. M.W.R.

N65-31304 Joint Publications Research Service, Washington, D. C.
SOME PROBLEMS IN THE THEORY OF SYSTEMS WITH MODULATED CAPACITANCE AND RESISTANCE
Ye. S. Karmanova and V. S. Etkin *In its* Izv. VUZov: Radiofiz., Vol. VIII, No. 2, 1965 10 Aug. 1965 p 276–281 refs (See N65-31275 20-23) CFSTI: $6.00

Results are tabulated for selecting optimum characteristics of devices with modulated capacitance and resistance. Data is given for gain and noise for the C-modulator and the RC-modulator, and it is shown that the characteristics of the two modulators practically coincide. A system of equations is developed. M.W.R.

N65-31493# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MEASUREMENT, CONTROL, AND REGULATION (AUTOMATION)
12 May 1965 32 p refs Transl. into ENGLISH of 2 articles from Messen, Steuern, Regeln (E. Germany), v. 7, no. 4, 1964 p 153–157, 162–166
(FTD-TT-64-1341/1+2; AD-467364)

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1. MEASUREMENT OF SPECIAL CHARACTERISTIC VALUES (MATRIX ELEMENTS) ON CONSTRUCTION ELEMENTS OF CONTROL TECHNIQUE H. Strobel p 1–14 refs (See N65-31494 20-10)

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N65-31494 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MEASUREMENT OF SPECIAL CHARACTERISTIC VALUES (MATRIX ELEMENTS) ON CONSTRUCTION ELEMENTS OF CONTROL TECHNIQUE
H. Strobel *In its* Meas., Control, and Regulation (Automation) 12 May 1965 p 1–14 refs (See N65-31493 20-10)

The realm of characteristic value research can be divided into three subdivisions. One of these three is the determination of characteristic values on universally applicable elements in order to establish hypotheses for the most accurate synthesis of technical control installations using several transmission links. As an example of this method, the determination and appropriate presentation of the dynamic behavior of energy transmitting elements such as electrical amplifiers and motors are considered. The characteristic value method makes possible a description which can prove of great advantage in the design of controls for non-retroaction free, linearized construction elements. E.E.B.

N65-31495 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COMPARISON OF FREQUENCY CURVE MEASURING METHODS WITHIN INSTANCES OF RANDOM INTERFERENCES
F. Mesch *In its* Meas., Control, and Regulation (Automation) 12 May 1965 p 15–27 refs (See N65-31493 20-10)

Periodic excitation as a method for measuring the dynamic characteristic values of linear control circuit components is considered. The phase null and watt meter methods are discussed as examples of frequency curve measuring methods with sinusoidal test signals. The measuring time for both methods is preferred for weak as well as strong interferences. E.E.B.

N65-31504# Texas Univ., Austin.
ADAPTIVE THRESHOLD LOGIC
Richard Gene Chappell (M.S. Thesis) May 1965 108 p refs
(Contract AF 33(608)-1121)
(AD-617412)

The design and construction of a 16 variable threshold logic gate with adaptable weights is described. The operating characteristics of tape wound magnetic cores when used as an analog memory element are presented. Magnetic properties of the cores are discussed and a test procedure is proposed which will simplify the determination of optimum parameter values for an adaptive weight. Test results are shown for several different core materials and sizes as well as for the 16 input adaptive threshold logic gate. Author

N65-31628# Research Triangle Inst., Durham, N. C.
INTEGRATED SILICON DEVICE TECHNOLOGY. VOLUME VII: OXIDATION
R. P. Donovan Jun. 1965 285 p refs
(Contract AF 33(615)-1998)
(ASD-TDR-63-316, Vol. VII; AD-618704)

The kinetics of high temperature reactions of silicon with steam (either in an open tube or a high pressure bomb), dry oxygen, and wet oxygen; and the kinetics of the anodic reaction of silicon with various electrolytes or plasmas at room temperature is discussed with a view towards developing and designing silicon integrated devices. Results from typical experimental systems are presented. Suitable apparatus for depositing oxides by pyrolytic decomposition, reactive sputtering, or vacuum evaporation is described; and the effect of impurities upon

the bulk physical and electrical properties of commercial glasses is discussed to suggest the type of variations in properties that might be anticipated with similar variations of the impurity content of oxide layers. Procedures for obtaining high quality thermal oxides, and for measuring the thickness of any oxide layer on silicon are given. Also included are a mathematical derivation of relations between measured radial dimensions for a lens, and the step height in the Newton's rings method; and a derivation of the fundamental equation of ellipsometry along with Archer's solution to it. L.S.

N65-31874# New York Univ., N. Y. Lab. for Electroscience Research.
NETWORK PROPERTIES OF DISTRIBUTED RC NETWORKS WITH ARBITRARY GEOMETRIC SHAPES Fifteenth Scientific Report
John J. Kelly and Mohammed S. Ghausi Mar. 1965 180 p refs *Its* Tech. Rept.-400-107
(Contract AF 19(628)-379)
(AFCRL-65-312; AD-617888)

This report presents a systematic study of the network properties of distributed RC networks having one dimensional spatial variation and arbitrary geometric shapes. The report considers analytic and approximation techniques which can be used to obtain the two-port immittance parameters of the distributed RC networks. Various methods are introduced for finding the pole-zero patterns of the immittance parameters. Approximation techniques are also included to find the effective dominant zero and the excess phase, within a specified error, of network functions having an infinite number of roots on the negative real axis. It is shown how such approximations can be utilized to obtain the key features of the steady state and the transient response of distributed RC networks. Examples of the various methods are given so as to make the techniques more palatable for circuit engineers. Extensive numerical tables are presented to show the effectiveness of the various methods as well as to develop appreciation for the understanding and handling of distributed RC networks. Author

N65-31942# Polytechnic Inst. of Brooklyn, N. Y. Electrical Engineering Dept.
STOCHASTIC TIME-OPTIMAL CONTROL
Prentiss N. Robinson Jun. 1965 56 p refs
(Contract AF 49(638)-1402)
(PIBMRI-1268-65; AD-467504)

The problem under study is the stochastic time-optimal control problem. Basically the object is to determine a control input which causes the output of a stochastic system to reach some region R of the origin in such a way that the expected value of the time required to reach R is minimized. The system is assumed to satisfy a stochastic differential equation. This problem has already been considered by a few authors, however in most cases serious errors were made in their analysis and problem statement. In this study a careful problem statement is made, appropriate optimization equations derived, and an iterative method of solution technique (approximation in policy space) is applied to solve certain specific problems. Author

N65-31993# Illinois Univ., Urbana.
DESCRIBING FUNCTION ANALYSIS FOR NONLINEAR SAMPLED DATA CONTROL SYSTEMS
John Malcolm Mac Callum, Jr. (Ph.D. Thesis) Wright-Patterson AFB, AF Inst. of Technol., 1965 96 p refs
(AFIT-TR-65-5; AD-617323)

The describing function theory was applied to the nonlinear sampled data problem by use of the Fourier analysis, to evaluate the output signal as an infinite series of sinusoidal functions at harmonics of the error signal frequency. The relationship between the discrete describing function and the general sinusoidal describing function used was determined, and the relative accuracy of the two approaches was analyzed. Both methods were essentially equal in accurately describing functions of a low pass system; the sinusoidal approach was better in frequency transfer computations for functions of complicated plants. Several examples of harmonically induced limit cycles were demonstrated by error signals from analog computer simulation of a relay with a dead zone sampled system. G.G.

N65-32060# Illinois Univ., Urbana. Coordinated Science Lab.
TIME OPTIMAL CONTROL OF NON-LINEAR SAMPLED-DATA SYSTEMS
Soe M. Win May 1964 72 p refs
(Contract DA-28-043-AMC-00073(E))
(R-210; AD-601622)

Procedures for the investigation of controllability, attainability and reachability of sampled-data systems with saturation constraints are presented. Necessary and sufficient conditions for complete controllability, attainability and reachability of single-input, time-invariant, sampled-data systems with saturation constraints are given. Conditional controllability, attainability and reachability are introduced and sufficient conditions are derived. Complete controllability and attainability of time-varying systems are investigated also. Simple sufficient conditions are derived when the system matrices are either asymptotic to constant matrices or periodic. Procedures for the formulation of optimal strategies are discussed. The optimal strategy used in this thesis involves forcing the system to the boundary surface first, and then to the desired state. The above procedure is not only simple, but also applicable to both time-invariant and time-varying sampled-data systems of arbitrary order. Author

N65-32061# Illinois Univ., Urbana. Coordinated Science Lab.
OPTIMAL SINGULAR SOLUTION FOR LINEAR, MULTI-INPUT SYSTEMS
R. A. Rohrer and M. Sobral, Jr. Apr. 1964 24 p refs
(Contract DA-36-039-AMC-02208(E))
(R-199; AD-601177)

The optimal singular control for a useful class of systems is obtained. Linear, stationary systems with multiple inputs when subject to performance indices quadratic in the state variables, but explicitly independent of the control variables may be optimally governed by singular control. The means of obtaining the singular behavior and control of derived and an explicit formula for the singular control is provided. Author

N65-32097*# Westinghouse Electric Corp., Baltimore, Md. Westinghouse Defense and Space Center.
RESEARCH ON FAILURE FREE SYSTEMS Quarterly Report No. 3, 20 Apr.–20 Jul. 1964
[1964] 5 p
(Contract NASw-572)
(NASA-CR-58861; WGD-38521) CFSTI: HC $1.00/MF $0.50 CSCL 09C

The four major tasks considered in this report are: statistical measure of quality, adaptive voter, failure responsive system organizations, and medium communication. A brief summary of the work proposed for each of these tasks is presented with a review of the progress made. The objective of this research is to develop new techniques that will advance the state-of-the-art concerned with ultrareliable electronic systems. A detailed study was made of the possible sources of error which might be made in estimating system reliability under various test conditions. Also, it was shown that voting circuits with certain adaptive capabilities are potentially more effective in combating the effects of failures than are currently used majority-voting circuits. A computer program was written using many of the minor concepts of a previously developed program but based on the spare-list technique. E.E.B.

N65-32110# Illinois Univ., Urbana. Coordinated Science Lab.
OPTIMAL CONTROL OF LINEAR SYSTEMS WITH TIME LAG
Thomas Edwin Mueller Jun. 1965 46 p refs
(Contract DA-28-043-AMC-00073(E))
(R-254; AD-618332)

New results are given which permit a numerical solution of the optimal regulator problem for systems governed by linear differential-difference equations in which the optimization interval is finite. An iterative algorithm which assures convergence to the optimum is derived from the necessary and sufficient conditions for optimality. This algorithm requires neither the choice of an initial control nor the choice of a convergence parameter. The conditions for optimality are derived in two forms: an integral equation and a coupled set of differential-difference equations. Numerical examples for this problem are presented. Author

N65-32218# Illinois Univ., Urbana. Coordinated Science Lab.
OPTIMIZATION OF SYSTEMS WITH PULSE-WIDTH MODULATED CONTROL
Donald E. Kirk (Ph.D. Thesis) Jun. 1965 76 p refs
(Contract DA-28-043-AMC-00073(E))
(R-255; AD-618325)

A new procedure for optimizing the performance of pulse-width-modulated systems is given for plants which may be nonlinear and time-varying. A modified Bolz performance index is employed. The optimization is formulated as a multiple-arc problem of the calculus of variations. Necessary conditions for optimal control are given in the form of a nonlinear two-point boundary value problem. The method of steepest descent is applied to obtain numerical solutions. A computational procedure is found which is especially suited to this type of problem. Special features of the procedure are automatic step size adjustment, and the generation of a sequence of performance indices which is monotonic. Examples which illustrate the range of application are given. Author

N65-32301# Illinois Univ., Urbana. Coordinated Science Lab.
GENERATIONS OF TREES WITHOUT DUPLICATIONS
W. Mayeda and S. Seshu Jul. 1964 22 p refs
(Contracts DA-28-043-AMC-00073(E); AF 49(638)-1383)
(R-220; AD-604653)

A procedure for generating all trees of a linear graph without duplication is described. The trees are generated in a systematic fashion by elementary tree transformations (replacement of one branch), and the sign computation is easily performed. Since the procedure guarantees that there is no duplication, networks in which the number of trees exceeds the fast memeory in a computer can be handled. It is required that one generate a starting tree, which is easy to do on a machine, and that one can compute the fundamental cut-sets for a given tree. R.W.H.

N65-32370# Joint Publications Research Service, Washington, D. C.
ON THE COMPLEXITY OF GATE CIRCUITS REALIZING BOOLEAN MATRICES WITH INDEFINITE ELEMENTS
E. I. Nechiporuk 30 Aug. 1965 8 p ref Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 163, no. 1, 1962 p 40-42
(JPRS-31762; TT-65-32257) CFSTI: $1.00

The synthesis of control systems with an incomplete set of input values, i.e., systems in which certain combinations of input values are excluded, is considered. The functioning of such systems with excluded combinations creates possibilities for the minimization of the circuitry. From this point of view, the gate circuits are examined and a method of synthesis is presented. It is shown that the circuit complexity is determined asymptotically only by the number of cells in which the conductivity matrix is defined and does not depend on the arrangement of the cells. E.E.B.

N65-32383# Illinois Univ., Urbana. Graduate Coll.
SYNTHESIS OF THREE-LEVEL LOGIC CIRCUITS WITH APPLICATION TO A RADIX THREE COMPUTER ARITHMETIC UNIT
Thomas Alois Rozmarich (M.S. Thesis) 28 May 1965 64 p refs
(AD-617298)

Adder circuits for use in a radix three computer are described and the applicability of three level logic operations discussed. The approach to synthesis parallels that of the binary case in that combinational logic operations as the AND, OR, and NOT, are used in the design to generate the required functions. The first circuits presented are those of a half and full adder designed entirely with three-level ANDs, ORs, and NOTS. Considered are definitions of the logic operations and the question of whether the rules of Boolean algebra apply. After presentation of the initial designs, the electrical equivalents of the three-level AND, OR, and NOT are considered, followed by simplified versions of the initial circuits in which the results of the electrical considerations play a large role in the simplification, thuse presenting two approaches to the design of radix three adder circuits. S.C.W.

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N65-31558# California Univ., Berkeley. Lawrence Radiation Lab.
200 BEV ACCELERATOR DESIGN STUDY, VOLUME I
Jun. 1965 500 p refs Sponsored by AEC
(UCRL-16000, Vol. I) CFSTI: $10.25 (2 Vol.)

A design study is presented for a 200 BeV strong focusing proton synchrotron. The scientific justification of the accelerator is discussed and descriptions are included of the general layout; orbits and structures; magnet system, magnet support, adjustment, foundation, survey, and enclosure; vacuum system; accelerating system; injection system; beam extraction system; and control system. In addition, radiation problems, the experimental use of the synchrotron, site criteria, and the physical plant are discussed. R.N.A.

N65-31559# California Univ., Berkeley. Lawrence Radiation Lab.
200 BEV ACCELERATOR DESIGN STUDY, VOLUME II
Jun. 1965 287 p refs Sponsored by AEC
(UCRL-16000, Vol. II) CFSTI: $10.25 (2 Vol.)

Schematic drawings and graphical data are presented as part of a design study for a 200 BeV accelerator. Additional graphical data are included on the experimental use, construction cost and schedules, and future possibilities of the accelerator facility. The appendix contains a feasibility study on compressible soil and shallow rock foundations for the accelerator facility. R.N.A.

N65-31584# ARO, Inc., Arnold Air Force Station, Tenn.
INITIAL OPERATION OF THE PILOT COUNTERFLOW TEST UNIT (1)
Henry W. Ball Arnold Eng. Develop. Center, Jul. 1965 39 p refs
(Contract AF 40(600)-1000)
(AEDC-TR-65-132; AD-465893)

A small counterflow test unit which consists of a shock tunnel and a hypervelocity launcher is being evaluated at the VKF, AEDC. The results of the shock tunnel calibration, the performance of the model launcher system, counterflow operating experiences, and some preliminary measurements of shock-cap radiation are reported. The shock tunnel calibration data for a room-temperature, helium driver gas are shown to confirm theoretical calculations and indicate clean uniform flow during a 4- to 5-msec run time. Aluminum spheres of 0.95-cm diam (0.375 in.) were launched with a 2-stage, light-gas gun at velocities between 4.0 and 5.5 km/sec (13000 and 18000 fps). During counterflow runs, relative velocities up to 7.5 km/sec (25000 fps) were attained. Measurements of total radiation from the shock-caps of the small spheres are in reasonable agreement with theories and previous measurements from free-flight and shock-tube facilities. Author

N65-31610 Naval Ordnance Lab., White Oak, Md.
NOL HYPERBALLISTICS TUNNEL NO. 4 RESULTS I: AIR LIQUEFACTION
P. Wegener, E. Stollenwerk, S. Reed, and G. Lundquist 4 Jan. 1951 67 p
(NAVORD-1742)

Since the presence of condensed air in a hypersonic wind tunnel can make the operation of the tunnel difficult, and since liquefaction can occur when the temperature and pressure in the test section are below the condensation values, an investigation was carried out on the liquefaction of air in a hypersonic wind tunnel. The tunnel used was built to operate at Mach numbers up to 11. The liquefaction was investigated under conditions in which the temperature and pressure of the supply air could be varied. It was found that air, unlike water vapor, does not supersaturate and heating of the supply air is required for satisfactory operation of a hypersonic wind tunnel. Experimental measurements show that a portion of the air condenses at or shortly after it reaches the predicted conditions for equilibrium-saturation in the nozzle. By maintaining a high temperature in the supply air the various standard methods for measuring the Mach number were found to give consistent Mach number data. Author

N65-31742# European Co. for the Chemical Processing of Irradiated Fuels, MOL (Belgium).
PRESSURE REGULATORS FOR AIR PULSATION
A. Hall, J. Perez-Sanchez, G. F. Lazzaretto, and A. Redon Jan. 1964 50 p refs
(NP-14446; ETR-161)

Three pressure regulators, namely the Airpack, the Airdron and the Nullmatic 40, usually used for supplying the air in air control systems, have been widely tested in pulsation service. Results presented here cover two groups of experiments and give extensive data on behavior, range and stability of the regulators. Comparative tables and diagrams are also included. It has been found that the pulse amplitude is not dependent on the type of pressure regulator; and it is stressed that only the Nullmatic 40—air supplied at high pressure—could fulfil the requirements of columns, like the C2, having a large air consumption. Author

N65-31796# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
ON THE USE OF A j × B ACCELERATOR TO IMPROVE SHOCK TUNNEL PERFORMANCE
Stefan Schreier Feb. 1965 129 p refs
(RE-202)

The design of higher speed aircraft has led to a corresponding demand for wind tunnels capable of testing such aircraft. Means are also sought to recreate re-entry conditions for testing lunar and planetary vehicles whose re-entry speeds are minimally considered in the 35000 to 40000 fps range. One of the devices being considerd to fill this gap is a j × B accelerator, which would be used to increase the velocity of air in a shock tube. This work consists of four parts: a review of the general theoretical work that has been done on j × B accelerators, a review of the experimental work that has been done with j × B accelerators, a discussion of the losses that might be encountered in j × B accelerators, and some detailed calculations designed to show to what extent unseeded air may be accelerated in a shock tube j × B accelerator combination. Author

N65-31824# Midwestern Universities Research Association, Madison, Wis.
THE DESIGN OF PROTON LINEAR ACCELERATORS FOR ENERGIES UP TO 200 MEV
B. Austin, T. W. Edwards, J. E. O'Meara, M. L. Palmer, D. A. Swenson, and D. E. Young 1 Jul. 1965 165 p refs Prepared for Argonne Natl. Lab. Sponsored by AEC
(MURA-713) CFSTI: $5.00

A study of proton linear accelerators of energy up to 200 MeV using drift tube loaded cavities resonant at 200 Mc is described. Such an accelerator is useful as an injector for a high energy synchrotron. Two computer programs have been used extensively in this study; one is used to calculate the resonant frequency and rf fields in the appropriate linear accelerator geometry, the other is used to calculate particle motion in the accelerator. From the field computational program a variety of resonant cavity configurations have been investigated, and an optimum structure has been chosen on the basis of minimizing the rf power costs and the structure length costs. Several optimized sets of parameters for a linear accelerator are given. More detailed studies were done on one of the sets of parameters including particle dynamics studies. Tables of drift tube dimensions are given. Author

N65-31960# Naval Ammunition Depot, Crane, Ind.
THE INVENTION OF A NEW TYPE OF FRICTION SENSITIVITY APPARATUS
Carl Armour and Lloyd Smith 11 Jun. 1965 26 p
(RDTR-60; AD-617382)

A new type of test apparatus has been invented which obtains an absolute value in foot-pounds for the frictional energy required to ignite explosives, pyrotechnics, propellants and other high energy compositions. The device obtains the frictional energy of ignition by spinning a rod on the sample held in an alundum sample holder. This energy is calculated from the torque load, the deflection, the revolutions per minute and the time to fire. Reproducibility of test results using duplicate samples is within a 1% to 2% range. Author

N65-31988# Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronautics and Astronautics.
DEVELOPMENT OF AERONAUTICAL ENGINEERING AT MIT
Shatswell Ober May 1965 23 p refs

Research laboratories established between 1933 and 1960 are discussed in terms of facilities, endowments, and general projects undertaken. Wind tunnel laboratories include the Wright Brothers Memorial; speckled pup, boundary layer, flutter, second student, and blowdown tunnels; and the Naval Supersonic Laboratory. Facilities for experiments in still air are mentioned; and laboratories for aeroelastic and structures research and instrument development and instrumentation are discussed. M.W.

N65-31991# Naval Research Lab., Washington, D. C.
A FLEXURAL FATIGUE MACHINE FOR HIGH-TEMPERATURE OPERATION AT RESONANCE IN VACUUM
M. R. Achter, H. H. Smith, R. L. Stegman, and R. J. Riley 11 Jun. 1965 21 p refs
(NRL-6275; AD-617915) CFSTI: $1.00

A resonance type reversed-bending, high-temperature fatigue machine for operation at constant bending amplitude in vacuum has been developed. The vibration frequency is maintained at resonance by means of a feedback circuit employing a capacitance pickup. Another circuit maintains a constant amplitude of vibration. As fatigue cracks are developed, the resonant frequency is reduced. Curves of resonant frequency versus time at 800° C for materials of high damping, such as Type 316 stainless steel, and for materials of low damping, such as Inconel X, illustrate the development of fatigue damage. Author

N65-32005# Martin Co., Baltimore, Md.
DESIGN, FABRICATION, AND INSTALLATION OF SIX-DEGREE-OF-FREEDOM SPACE MAINTENANCE SIMULATOR Final Report, 26 Jan.–28 Jul. 1964
A. E. Holmes Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Apr. 1965 94 p refs
(Contract AF 33(615)-1250)
(AFAPL-TR-64-129; AD-617423)

A 6-degree-of-freedom space maintenance simulator was designed, fabricated and installed for USAF Aero Propulsion Lab., WPAFB. The simulator supports a 180 lb subject and 110 lb back pack with unlimited freedom in pitch, roll, and yaw; horizontal translation on frictionless air pads over a 20 × ft floor; and vertical translation on air bearings ±18 in. from a nominal position. Also, included was a servo controlled work panel capable of horizontal translation simulating a 3K to 7K lb object in orbit. The work panel is suspended from a 20 ft span bridge crane with both axes controlled by servo amplifiers housed in a single rack. A 140 SCF air tank provides a low rate air spring for vertical translation. Author

N65-32006# Naval Ordnance Lab., Corona, Calif.
NOLC FACILITIES FOR VERY-LOW-FREQUENCY RESEARCH
Richard H. Espeland 14 Jun. 1965 59 p
(NOLC-623; AD-617532)

The history and development of the U.S. Naval Ordnance Laboratory, Corona, California, Lucerne Valley field site for very low frequency research is presented along with concise descriptions of its facilities, capabilities, equipment, and brief reports on presently conducted projects. The research projects include the sferic correlation detection system, very low frequency transmitting antenna research, solar flare warning system, very low frequency receiving antenna performance evaluation, very low frequency direction finding antenna research, very low frequency vertical incidence sounder, and investigation of sferics properties. R.N.A.

N65-32092*# Ion Physics Corp., Burlington, Mass.
A PRELIMINARY DESIGN STUDY OF A MICROPARTICLE ACCELERATOR Final Report, 30 Jan.–13 Apr. 1964
K. W. Arnold, R. B. Britton, R. N. Cheever, A. S. Denholm, S. V. Nablo et al [1964] 64 p refs
(Contract NAS2-1873)
(NASA-CR-56191) CFSTI: HC $3.00/MF $0.75 CSCL 20G

The preliminary design considerations for a proposed 2 MV microparticle accelerator are discussed. The primary objectives in the study were the attainment of minimum particle path length, very low environmental pressure ($\sim 10^{-8}$ torr), accommodation to a possible 10% particle charge loss in flight, and a capability of future extrapolation to higher voltages in a machine having both the particle source and target assembly at ground potential. The design which has evolved is a four-stage device in which the particle is sequentially accelerated into drift tubes at 500 kV negative potential which are then switched to ground while the particle is shielded inside. A complete description of the accelerator and the method of installation on the proposed site as well as descriptions and specifications of component parts is provided. Author

N65-32096*# Ion Physics Corp., Burlington, Mass.
A PRELIMINARY DESIGN STUDY OF A MICROPARTICLE ACCELERATOR Final Report, 14 Apr.–6 Jul. 1964
K. W. Arnold, R. N. Cheever, A. S. Denholm, R. E. Elcox, J. E. Lavelle et al [1964] 30 p
(Contract NAS2-1873)
(NASA-CR-58647) CFSTI: HC $2.00/MF $0.50 CSCL 20G

Design considerations, drawings, and circuit diagrams for a single stage prototype microparticle accelerator are presented. Qualification tests are also described which will assess the reliability of the system and its components and confirm that they operate according to specifications. Author

N65-32126# Oklahoma Univ., Norman. Graduate Coll.
THE DESIGN AND CALIBRATION OF A VERY LOW SPEED OPEN CIRCUIT WIND TUNNEL
Richard Allan Milburn (M.S. Thesis) 1965 92 p refs
(AD-617284)

Described are design criteria and experimental procedures used in the construction of a very low speed open circuit wind tunnel for studying the behavior of flames of various hydrocarbons burning in liquid pools and under control wind conditions. Speculation is made concerning the significance of the tunnel as a test bed for further experimentation in low speed fluid dynamics, particularly in the area of model testing of VTOL and STOL aircraft. S.C.W.

N65-32136# National Academy of Sciences—National Research Council, Washington, D. C. Materials Advisory Board.
DISSEMINATION OF INFORMATION ON MATERIALS: AN ANALYSIS OF A SURVEY OF MATERIALS, INFORMATION USERS TO DETERMINE EFFECTIVENESS OF INFORMATION DISSEMINATION
Nathaniel C. Fick and Wyvona A. Lane, comp. 1964 48 p
(MAB-66-SM; AD-461639)

An evaluation of the Department of Defense materials information centers and collections from the standpoint of the user of materials information is presented along with a limited survey covering broad aspects of the dissemination of materials information. Materials users in industry, government, research institutes, and the universities feel that the Department of Defense is doing all that it should in the dissemination of information. However, survey results indicate that the centers and collections and their coverage, services, and accessibility should be publicized more effectively. Analyses show that those interested in research materials make little use of the Department of Defense centers in their quest for information. The Defense Metals Information Center is the most used information center. Person-to-person contact was emphasized by many as the only effective way to obtain certain types of information. Up-to-date lists of experts and authorities, with clear indication of field of knowledge, are in great demand. R.N.A.

N65-32146# Societe d'Etudes, de Recherches et d'Applications pour l'Industrie, Brussels (Belgium).
DESCRIPTION OF A LOOP FOR DYNAMIC CORROSION TESTS IN WATER OF HIGH TEMPERATURE [DESCRIPTION D'UNE BOUCLE POUR ESSAIS DYNAMIQUES DE CORROSION DANS L'EAU A HAUTE TEMPERATURE]

W. Vanmol, R. Hennaut, J. Waty, and W. R. Ruston EU ,TOM, 1965 26 p In FRENCH; ENGLISH summary
(Contract EURATOM-089-62-7 RDB)
(EUR-1744.f; EURAEC-1061) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 40 Belg. Fr.

The loop is specially designed for dynamic corrosion tests at high temperature in high-purity water or water containing additives. The maximum values for the test parameters are 335° C for the temperature, 170 kg/cm^2 for the total pressure, 25 m^3/h for the flow-rate and 10 m/sec for the water circulation rate on the samples in the present geometry of the test sections. The principle on which operation of the rig is based is described in detail. The material and equipment used in the main and secondary circuits are all of stainless steel. This equipment and that of the auxiliary circuits are described, as well as the extent to which they are interdependent. The account of the characteristics of the unit is completed by a description of the electric control equipment and the automatic alarm and safety devices. Operation of the loop is illustrated by a description of a brief running procedure. Author

N65-32324# Sandia Corp., Albuquerque, N. Mex.
A CONTROLLED THERMAL ENVIRONMENT FOR DIELECTRIC BREAKDOWN STRENGTH STUDIES
Lee J. Seligman [1964] 5 p refs
(Contract AT(29-1)-789)
(SC-DC-64-1002; CONF-769-5)

A small automatic temperature chamber is described in which it is possible to conduct dielectric breakdown strength tests and similar studies over the range of −10° C to +210° C with ±0.1° C stability. Dielectric tests were made with electrodes of two types; an ASTM electrode combination of nickel-plated brass and an imbedded $y = 0.4\pi$ contour coated with metallic paint to which the ASTM electrodes provide electrical contact. In both cases, positive voltage pulses of about 20 μsec duration were applied once per second, each successive pulse increasing in amplitude by 2.5 kV until breakdown occurred. Using the first of these electrode configurations, Hysol epoxy 13-009 in flat sheets 4 inch by 4 inch and having various thicknesses was tested to determine its dielectric strength versus thickness and temperature. In a second group, three materials were tested with the $y = 0.4\pi$ electrode: Diall 52-20-30; Diall FS-4; and Plaskon 422. Data are given for all tests. E.E.B.

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N65-31368# Rice Univ., Houston, Tex.
SIMILARITY LAWS FOR OPTIMUM HYPERSONIC BODIES
Aero-Astronautics Report No. 4
Angelo Miele 1965 26 p refs
(Grant AF-HFOSR-828-65)
(AAR-4; AD-468761)

The problem of determining the longitudinal and transversal contours minimizing the drag of a body in hypersonic flow is considered under the hypothesis that the pressure distribution is Newtonian and the skin-friction coefficient is constant. It is assumed that the body is slender and homothetic and that certain arbitrarily prescribed values are assigned to—at most—the length, the base width, the wetted area, and the volume. Two similarity laws are determined. Author

N65-31516# Aeronautical Research Council (Gt. Brit.)
THE CHANGE IN SHOCK-TUNNEL TAILORING MACH NUMBER DUE TO DRIVER GAS MIXTURES OF HELIUM AND NITROGEN
L. Pennelegion and P. J. Gough 1965 19 p refs Supersedes NPL-AERO-1103; ARC-25102; See X64-16272
(ARC-R&M-3398; NPL-AERO-1103; ARC-25102) HMSO: 8s

Comparison is made of the pressure recovery and available testing time of a shock tunnel using room-temperature nitrogen, helium or a mixture of these as the driver gas. It is shown that tailoring can be obtained from M_s = 1·0 to 3·4, resulting in an improvement in pressure recovery and testing time. Author

N65-31528# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ON REGULARITIES OF VISCOUS GAS MOTION IN A SHOCK TUBE
A. I. Lashkov [1965] 7 p refs Transl. into ENGLISH from Inzh. Zh. (USSR) v. 5, no. 2, 1965 p 254–260

Shock tube experiments were conducted with air and argon, and the results are analyzed under the assumption that the difference between the incident shockwave velocity c and the velocity of the bow part of the contact domain u_2 is constant if $c > u_2$. It was found that the relative duration of the flow behind the shockwave (plug length) in the shock tube for Reynolds number (Re) less than or equal to 4000 is determined by the Re value. Also, it appears that gas flow regimes always occur in the shock tube when an increase in the length of the tube does not increase the plug length. Finally, it is concluded that when comparing two perfectly identical gas flow regimes in shock tubes of different diameters with Re $\leq$ 4000, the absolute value of the plug length will be proportional to the square of the diameter. J.M.D.

N65-31534# Aeronautical Research Council (Gt. Brit.)
ANNULAR CASCADE EXPERIMENTAL INVESTIGATIONS OF CONICAL ACTUATOR DISC THEORY AND OF NON-UNIFORM FLOW THROUGH PLANE WALLED DIVERGING OR CONVERGING DUCTS
R. I. Lewis (English Electric Co., Ltd.) 1965 60 p refs Supersedes ARC-25168
(ARC-CP-766; ARC-25168) HMSO: 8s 6d

A description is given of wind tunnel experimental investigations of rotational flows through diffusers and contractions. The purpose of the investigations was to test the accuracy of a theory previously derived for two-dimensional plane walled diverging or converging ducts and of actuator disc theory for conical annuli. Conical flow tests were made in one case with a free vortex blade row of large deflection. Other tests were made with an axial compressor inlet guide vane nozzle generating a small swirling velocity distribution close to solid rotation. Particular attention is drawn to the separate influences exerted by two vorticity components orginating from gradients of stagnation pressure and of fluid angular momentum. Author

N65-31571*# Toronto Univ. (Ontario).
INTEGRAL METHODS IN COMPRESSIBLE LAMINAR BOUNDARY LAYERS AND THEIR APPLICATION TO HYPERSONIC PRESSURE INTERACTIONS
Yat-Yung Chan Washington, NASA, Sep. 1965 99 p refs
(Grant NsG-633)
(NASA-CR-284) CFSTI: HC $3.00/MF $0.75 CSCL 20D

Properties of compressible laminar boundary layers with heat transfer and arbitrary pressure gradients are calculated by combining integral relations and similarity solutions and by using both momentum and energy integral equations. An outline of the integral method for two-dimensional and asymmetric laminar boundary layers in compressible flows includes boundary layer and transformation equations and a method of one-parameter correlation. The method is applied to hypersonic

laminar boundary layers and calculations are made for self-induced pressure interactions in hypersonic flows. Solutions, which cover the complete range of interaction, agree with both experimental and more exact theoretical results. Consideration is also given to pressure interaction for real gases using weakly disassociated boundary layers; and calculations for a flat plate with a fully catalytic surface in a stream of oxygen indicate that boundary layer characteristics in this instance vary slightly from those of the perfect gas. M.W.R.

N65-31581# Michigan Univ., Ann Arbor. Aircraft Propulsion Lab.
THE EFFECT OF LONGITUDINAL VISCOSITY ON THE FLOW AT A NOZZLE THROAT
Martin Sichel Jun. 1965 64 p refs *Its* Rept.-05800-1-F
(Grant DA-ARO(D)-31-124-G385)
(AROD-3537-1; AD-467593)

An inviscid transonic theory appears to be inadequate to describe the flow near the throat of a converging-diverging nozzle during the transition from the symmetrical Taylor (1930) type of flow to the subsonic-supersonic Meyer (1908) flow. A viscous-transonic equation taking account of heat conduction and longitudinal viscosity has been developed previously (Cole 1949, Sichel 1963, Szaniawski 1963). An exact nozzle type of similarity solution of the viscous-transonic equation, similar to the inviscid solution of Tomotika and Tamada (1950), has been found. This solution does provide a description of the gradual transition from the Taylor to the Meyer flow and shows the initial stages in the development of a shock wave downstream of the nozzle throat. The solution provides a viscous shock like transition from an inviscid supersonic accelerating flow to an inviscid subsonic decelerating flow. Author

N65-31597# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
DYNAMICS OF GAS-PARTICLE MIXTURES WITH FINITE PARTICLE VOLUME
George Rudinger Dec. 1964 28 p refs Presented at the AIAA 2d Aerospace Sci. Meeting, New York, 25–27 Jan. 1965
(Contract Nonr-3623(00); Proj. Squid)
(CAL-91-P; AD-456134)

In the analysis of two-phase flows in which a gas carries along a large number of small particles, the volume of the particles is customarily assumed to be negligible. This assumption often is well justified, but if either the mass fraction of the particles or the gas density is sufficiently high, the particle volume fraction may become significant. It is thus important to establish the conditions at which this parameter should be included in a flow analysis. The particles may be considered as incompressible by comparison with the gas so that a finite particle volume fraction appears as an additional variable in the basic equations. Consequences of a finite particle volume are examined for isentropic changes of the mixture, for frozen and equilibrium speed of sound, and for both the frozen flow immediately behind a shock wave and the equilibrium flow that is established further downstream. The errors which would result from neglecting the particle volume range from insignificant to large. For example, even for gas-particle density ratios as low as 10^{-3}, the equilibrium flow velocity behind a shock front is quite sensitive to changes of the volume of the particles if they represent more than one-half of the mass of the mixture. Author

N65-31614# Avco-Everett Research Lab., Everett, Mass.
TURBULENCE FRONT STATISTICS OF WAKES FROM BODIES IN HIGH-SPEED FLIGHT
Richard L. Schapker Jun. 1965 74 p refs
(Contracts DA-30-069-ORD-1955; AF 04(694)-414)
(AVCO-Everett-Res. Rept.-217; BSD-TR-65-158; AD-465055)

Some statistical characteristics of high-speed turbulent wake boundaries are presented. Data ranges from 16 to 5000 body diameters for all bodies, with free-stream Reynolds numbers $.25(10^6) \leq U_\infty d/\nu_\infty \leq 2(10^6)$. Statistical parameters measured include standard deviation σ_ξ and autocorrelation function $R_\xi(\xi)$ of front deviations about the mean, correlation microscale λ_ξ, and intermittency factor Γ. Evidence for periodic front structure is shown for both the sphere and cone wakes. Estimates are made thereby of turbulence dissipation rate, Kolmogoroff and energy-containing wave numbers, and Lagrangian integral time scale. Author

N65-31624# California Univ., Berkeley. Operations Research Center.
SEMI-NARROW CHANNELS
James Bigelow Jun. 1965 26 p ref
(Contract Nonr-3656(02))
(ORD-65-15; AD-618749)

The laws governing the flow of particles in either direction through a channel or passage wide enough so that the two particles can pass one another are derived. In the human red blood cell, measurements of permeability to water are made in two ways. If an actual osmotic pressure is introduced, the net rate of flow of water can be measured and as osmotic coefficient calculated. If osmotic balance is achieved, a diffusion coefficient can be calculated from the unidirectional water flow as measured with DHO. The result is that:

$$\mu_{osm} = 2.5\mu_{diff.}$$

Such a difference is explained by the theory presented. E.E.B.

N65-31757# Dartmouth Coll., Hanover, N. H. Thayer School of Engineering.
TWO-PHASE FLOW AND BOILING HEAT TRANSFER
Quarterly Progress Report, Apr.–Jun. 1964
G. B. Wallis, D. A. Steen, and J. M. Turner [1964] 16 p refs
(Contract AT(30-1)-3114-1)
(NYO-3114-3)

Void fraction data for vertical annular two-phase flow are reported. Results at three different pressures correlate satisfactorily. Changes in tube diameter and fluid properties produce deviations which are not yet fully understood. Author

N65-31777# Royal Aircraft Establishment, Farnborough, (England).
SOME RECENT RESULTS IN THE STUDY OF MIXING AND REATTACHMENT FLOW PROBLEMS [RESULTATS RECENTS DANS L'ETUDE DES PROBLEMES DE MELANGE ET DE RECOLLEMENT]
P. Carriere and M. Sirieix London, Min. of Aviation, May 1965 33 p refs Transl. into ENGLISH from ONERA Publ. TP-165, (France), 1964
(RAE-LIB-TRANS-1113)

Conical flow reattachment experiments were conducted in the absence of disturbances. These experiments confirm that the turbulent attachment criterion of Chapman–Korst should be modified. Experiments made in two dimensional and in axisymmetric flow in the presence of an initial turbulent boundary layer of negligible thickness lead to the same conclusion. However, it is not possible to put all these results together exactly in a single criterion of reattachment. An approximate criterion is presented which is different from that of Chapman–Korst. R.N.A.

N65-31791# Hydronautics, Inc., Laurel, Md.
THE LINEARIZED THEORY FOR A SUPERCAVITATING BIPLANE OPERATING AT ZERO CAVITATION NUMBER NEAR A FREE SURFACE

Tsuying Hsieh Oct. 1964 83 p refs
(Contract NObs-90224)
(TR-463-3; AD-459460)

A theoretical study, based on linearized theory, of the hydrodynamic characteristics of a supercavitating biplane operating at high speed near a free surface, for arbitrary depth of submersion, foil spacing, stagger angle, and relative chord length was carried out. Four section configurations were examined. These were: (1) flat plate, (2) constant pressure camber distribution, (3) two term camber distribution, and (4) quasi-parabolic thickness. Numerical results are presented and discussed. Author

N65-31809# Aeronautical Research Council (Gt. Brit.)
THE STEADY FLOW OF A VISCOUS FLUID PAST A CIRCULAR CYLINDER
S. C. R. Dennis (Sheffield Univ., England) and M. Shimshoni (Weizmann Inst. of Sci., Rehovoth, Israel) London, Min. of Aviation, 1965 44 p refs Supersedes ARC-26104; See X65-10970
(ARC-CP-797; ARC-26104) HMSO: 8s 6d

Using numerical methods described by Dennis and Dunwoody, the steady motion of a viscous, incompressible fluid past a fixed circular cylinder is investigated over the complete range of Reynolds numbers. In particular, the limit solution as the Reynolds number R becomes large is considered. The calculated drag coefficient is found to agree reasonably well with experimental measurements for low Reynolds numbers but starts to become higher for values of R greater than 30. The calculations show that a standing vortex pair, behind the cylinder, first appears at R = 5-6 which is in good agreement with the experimental results of Homann and Taneda. Author

N65-31818# General Dynamics/Astronautics, San Diego, Calif.
THE FLOW FIELD RESULTING FROM MACH REFLECTION OF A CONVERGENT CONICAL SHOCK AT THE AXIS OF A SUPERSONIC, AXIALLY SYMMETRIC JET
J. Bowyer, L. D'Attorre, and H. Yoshihara Jul. 1963 25 p refs
(Contract AF 04(647)-644; ARPA Order 153-60)
(GDA-0586; AD-463487)

The efflux of a jet into a quiescent medium where a Mach disk configuration arises from a nonuniformity of the flow at the nozzle exit has been calculated. The nozzle associated with this flow is reflexed and has an expansion ratio of 25, a 115 psia stagnation pressure of the supplied nitrogen, and an ambient pressure of 3.5 mm Hg. It was found that at the jet boundary and at the slip line viscous mixing will take place. Experimental results for this case show satisfactory agreement with the calculated locations for the subsonic region, as well as for the sonic line. G.G.

N65-31842# General Applied Science Labs., Inc., Westbury, N. Y.
ON THE MIXING AND INTERACTION OF COMPRESSIBLE VISCOUS AND INVISCID FLOWS
Martin I. Hoffert 15 Sep. 1964 68 p refs
(Contract NOw-63-0637-c(FBM))
(TR-402; AD-463484)

The pressure interaction of coupled viscous-inviscid flows is investigated analytically. Using an integral formulation the governing equations are derived following the method of Crocco and Lees. Details of the system are investigated for planar flows of a perfect gas where the deflection of the inviscid streamline at the boundary layer edge is given by the Prandtl-Meyer relation. The governing differential equations exhibit a critical point, the location of which depends on profile development in the viscous layer. To pass the computation through this critical point requires the imposition of a regularity condition which fixes one of the initial conditions. Although the location of the critical point is strongly dependent on profile shape a Kármán-Pohlhausen type profile is introduced for illustrative purposes and to evaluate explicitly several correlation functions which are required to close the system mathematically. Author

N65-31875 General Electric Co., Philadelphia, Pa. Re-Entry Systems Dept.
DEVELOPMENT OF HYPERSONIC NEAR WAKE ANALYSIS
F. Costello, J. Westlake, and J. Kirk 20 Nov. 1964 85 p refs
(Contract AF 04(694)-222)
(Doc.-64SD738; AD-355337) (Declassified)

An analytical technique for predicting the velocities, pressures, and enthalpies in the recirculation and post-neck regions of the wake immediately behind a reentry body travelling at hypersonic speeds is considered. It was concluded that: (1) Numerical solution of the steady flow equations in the recirculation region does not appear possible. (2) In the post-neck region, a non-zero-pressure gradient solution is shown to be mathematically possible, but numerical instabilities in the integration process need to be resolved before the solution can be practically attained. (3) A solution to the recirculation region flow appears promising through the numerical integration of the time dependent differential equations. E.E.B.

N65-31947# Nebraska Univ., Lincoln. Hydrodynamics Lab.
INVESTIGATION OF THE STABILITY OF PULSATING VISCOUS FLOW Final Report
Turgut Sarpkaya Jul. 1965 45 p refs
(Contract DASA-WEB-07.010; Grant DA-AROD(D)-31-124-0261)
(NU-HYDRO-022-TS; AROD-3202-2; AD-468742)

The critical Reynolds numbers, phase angles between the velocity and pressure, and the amplification and damping rates of turbulent plugs for Poiseuille flow pulsating under a harmonically and a nonharmonically varying pressure gradient were determined. The steady flow was laminar at the maximum capacity of the system which corresponded to a Reynolds number of 6500. Harmonic oscillations in the pressure gradient were produced by a scotch yoke mechanism and the nonharmonic oscillations by a slider crank mechanism. Two oils of different viscosities were used as the working fluid. The evolution of turbulent plugs generated by a tripping wire was monitored at three locations along the conduit by means of pressure transducers. The front and rear velocities, and growth and damping rates of turbulent plugs were determined for both steady and pulsating Poiseuille flow. R.N.A.

N65-31956# Aix-Marseilles Univ. (France). Inst. of Fluid Mechanics.
INITIALLY LAMINATED BOUNDARY LAYER, PHASE NO. 2, PERIOD OF 15 MARCH 1964 TO 15 MARCH 1965 [COUCHE LIMITE INITIALEMENT LAMINAIRE, PHASE NO. 2, PERIODE DU 15 MARS 1964 AU 15 MARS 1965]
[1965] 67 p In FRENCH
(NT-1/7648-AY; ONERA-510/521)

Experiments performed at Mach 7 dealing with the influence of the boundary layer of a smooth plate upon heat transfer to the surface of a cylinder incident to the plate are described. The effect of the boundary layer upon the heat convection flux, and the pressure on the surface of the plate and along the line of incidence of the cylinder is considered. It is shown that when the boundary layer of the plate is initially laminar, the transition is not observed, except locally, when the axis of the cylinder makes an angle greater than 40° with the plate. Transl. by G.A.L.

N65-32003# Carnegie Inst. of Tech., Pittsburgh, Pa.
UNCONVENTIONAL METHODS FOR INFLUENCING FLUID FLOW. PART II: ELECTROKINETIC PUMPING Final Report, Sep. 1963–Aug. 1964
George A. Mc Lennan Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., May 1965 75 p refs
(Contract AF 33(657)-9914)
(AFAPL-TR-64-133, Pt. II; AD-617725)

This volume consists of two sections. In the first section an analysis of electrokinetic energy convertors is presented. This analysis was executed in such a way as to permit comparisons to be made between devices employing different working fluids in which the charging mechanism may be different. Using experimental data from the literature, the conversion capability is predicted for water, various organic liquids, and liquid mercury. The general conclusion is that the efficiency of such devices does not ever appear to be very large. In the second section a series of experiments carried out on an electrokinetic pump using water as the working fluid are described in detail. The intention here is not only to indicate how well practice matches theory but to point out the numerous practical problems associated with the serious use of such devices as fluid pumps. The general conclusion is that uncertainties in the electrical properties of fluids cannot reasonably be avoided and act so as to make the prediction of the actual behavior of these devices very difficult. Author

N65-32018# Aeronautical Research Council (Gt. Brit.)
TURBULENT FLOW PAST TWO-DIMENSIONAL BASES IN SUPERSONIC STREAMS
R. C. Hastings London, HMSO, 1965 28 p refs Supersedes RAE-TN-AERO-2931; ARC-25737; see X64-14101
(ARC-R&M-3401; RAE-TN-AERO-2931; ARC-25737) HMSO: 11s

Experiments on the flow past two-dimensional, rearward-facing steps with turbulent approach boundary layers have been made at Mach numbers of 1·56, 2·41 and 3·10. Wide ranges of the ratio of boundary-layer thickness to step height were covered. The flow downstream of one step was briefly explored at a Mach number of 2·41. The base pressures are most conveniently expressed in terms of pressure-recovery coefficients for the flows downstream of the steps. Fairly good correlation of these coefficients is obtained by using the concept of local similarity upon which the measurement of skin friction by surface pitot tubes is based. Author

N65-32039*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
A STATISTICAL DERIVATION OF THE HYDRODYNAMIC EQUATIONS OF CHANGE FOR A SYSTEM OF IONIZED MOLECULES
Raymond J. Beshinske 5 Aug. 1965 148 p refs
(Grant NsG-275-62)
(NASA-CR-64536; WIS-TCI-110) CFSTI: HC $4.00/MF $1.00 CSCL 20D

Non-relativistic, classical statistical mechanics is used to describe a dense fluid of molecules composed of nuclei and electrons with a purely coulomb interaction potential. A general equation of change is derived for the time rate of change of any macroscopic (ensemble averaged) dynamical variable. From this general equation, Maxwell's equation in a medium and the hydrodynamic equations of change are derived and expressed in terms of molecular properties, e.g. polarization and magnetization densities. These equations are discussed in the limiting case of low density and compared with previous results. Author

N65-32088*# General Applied Science Labs., Inc., Westbury, N. Y.
AXISYMMETRIC LAMINAR AND TURBULENT JETS OF HYDROGEN WITH SIMPLE CHEMISTRY Technical Report No. 331
Harold Rosenbaum 4 Jan. 1963 60 p refs
(Contract NAS8-2686)
(NASA-CR-64434) CFSTI: HC $3.00/MF $0.50 CSCL 20D

The problem of a uniform axisymmetric jet of pure hydrogen issuing into a parallel free stream of air is discussed. There are considered both laminar and turbulent flows under the assumption that all Prandtl and Lewis numbers are equal to unity, and that the limiting chemical behaviors of frozen and equilibrium flow prevail; the flame sheet approximation is applied to the equilibrium model. Calculations are performed along a point on a typical trajectory for missile launch. Author

N65-32141# Aix-Marseilles Univ. (France). Institute of Fluid Mechanics.
THEORETICAL AND EXPERIMENTAL STUDY OF THE PHENOMENA ACCOMPANYING THE STARTING OF A HYPERSONIC NOZZLE [ETUDE THEORIQUE ET EXPERIMENTALE DES PHENOMENES ACCOMPAGNANT L'AMORCAGE D'UNE TUYERE HYPERSONIQUE]
J. Valensi, J. P. Guibergia, and B. Tocquet [1965] 68 p refs In FRENCH *Its* Probl. No. 7024 AY, Pt. 2
(NT-3/7024 Y)

The existence of two successive shock waves within a hypersonic nozzle during startup is established theoretically and verified experimentally. Transl. by J.M.D.

N65-32167# Polytechnic Inst. of Brooklyn, Farmingdale, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.
ON THE SOLUTION OF INITIAL-VALUED BOUNDARY LAYER FLOWS
Martin H. Steiger and Paavo Sepri May 1965 27 p refs
(Grant AF-AFOSR-1-63)
(PIBAL-872; AFOSR-65-1415; AD-619098)

This report is concerned with the exact solution of the boundary layer equations, particularly when the initial conditions are not of a simple form. A comparatively new procedure is applied to the forementioned problem, and the preliminary results of the investigation are reported here. The theory is restricted to flows which are described by two coordinates. By replacing the normal partial derivatives by finite differences the boundary layer equations are reduced to an initial value system of coupled first order ordinary differential equations. Since these equations are classified as "stiff", their solution requires special consideration. As an illustration, the velocity field of a two-dimensional wake is calculated, and the results are shown to be in good agreement with the solution obtained by full finite difference schemes. An improved theory is suggested and possible future studies are discussed. Author

N65-32185*# National Aeronautics and Space Administration, Washington, D. C.
FLOW OF A RELAXING GAS AROUND A THIN CONE OF REVOLUTION [OBTEKANIYE TONKOGO KONUSA VRASHCHENIYA RELAKSIRUYUSHCHIM GAZOM]
Yu. V. Khodyko Sep. 1965 9 p refs Transl. into ENGLISH from Dokl. Akad. Nauk Belorussk. SSR (USSR), v. 8, no. 8, 1964 p 509–513
(NASA-TT-F-334) CFSTI: HC $1.00/MF $0.50 CSCL 20D

The problem of supersonic flow around thin bodies of revolution by a gas, in which chemical reactions and relaxation of internal degrees of freedom take place, is reduced to the integration of a single differential equation. It is assumed that the linearized flow equations hold and that functions of

state exist. Using Laplace transformation methods, the author discusses flow close to the initial frozen Mach line, flow close to the surface of the cone, and the region far removed from the axis and the initial frozen Mach line. Author

N65-32249# Michigan Univ., Ann Arbor. Aircraft Propulsion Lab.
THE INTERACTION PROCESS BETWEEN GASEOUS DETONATION WAVES AND INERT GASEOUS BOUNDARIES Final Report
E. K. Dabora, J. A. Nicholls, and M. Sichel Jun. 1965 10 p refs *Its* Rept.-05170-3-F
(Contract DA-ARO(D)-31-124-G345)
(AROD-05170-3-F; AD-618107)

Abstracts and a general outline of theoretical and experimental investigations of the properties of gaseous detonation waves subjected to a compressible inert boundary are presented. Properties considered include propagation velocity, reaction length, quenching conditions, and wave shape. The first order solution of the hydrodynamic equation for the prediction of wave shape is summarized. G.A.L.

N65-32268*# National Aeronautics and Space Administration, Washington, D. C.
THE EFFECT OF INITIAL DISCHARGE ON THE DEVELOPMENT OF A SUBMERGED NONISOTHERMAL ROUND JET IN A NONCOMPRESSIBLE FLUID [VLIYANIYE NACHAL'NOGO RASKHODA NA RAZVITIYE ZATOPLENNOY NEIZOTERMICHESKOY KRUGLOY STRUI V NESZHIMAYEMOY ZHIDKOSTI]
F. Aliyev Jul. 1965 10 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (USSR), v. 7, no. 10, 1964 p 106–111
(NASA-TT-F-9495) CFSTI: HC $1.00/MF $0.50 CSCL 20D

The paper considers the problem of a submerged nonisothermal round jet taking into account the initial mass-flow rate. The method of asymptotic expansion is used to obtain the solution. The solution is used to carry out calculations for three values of the initial discharge into two sections of the jet with $\sigma = 0.72$. The relationship $\theta(\eta)$ is shown in figure 1, the ratio $\theta(\tau)/\theta_{max}$ is shown in figure 2 while the variation in θ_{max} along the axis is shown in figure 3. Author

N65-32331# California Univ., Berkeley. Lawrence Radiation Lab.
ANALYSIS OF GAS-PHASE MASS TRANSFER IN TURBULENT FLOWS
Darshanlal T. Wasan and Charles R. Wilke Sep. 1964 134 p refs
(Contract W-7405-ENG-48)
(UCRL-11629)

A general treatment of mass transfer between a smooth pipe wall and a fully developed turbulent flow is presented. An analysis of simultaneous exchange of mass and heat from single cylinders is made. A new correlation for the psychrometric ratio is presented based in part on the treatment of transfer of heat and mass in pipe flow. The proposed correlation compares favorably with available experimental data. Numerical solutions were developed for a forced-convection-diffusion system involving gas-phase non-equimolar turbulent diffusion in pipes with a constant concentration at the wall. Through these solutions it is concluded that the product of the gas-phase mass transfer coefficient and the film pressure factor at constant Schmidt and Reynolds numbers is nearly constant in the mass transfer entry region as well as in the fully developed regions. Author

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N65-31268*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
RESEARCH IN SPACE SCIENCES. SOME RESULTS AT SMITHSONIAN OBSERVING STATIONS Special Report
17 May 1965 40 p ref
(Grant NsG-87-60)
(NASA-CR-64269; SAO Special Rept.-176) CFSTI: HC $2.00/MF $0.50 CSCL 04A

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N65-31269* Smithsonian Astrophysical Observatory, Cambridge, Mass.
STATISTICS ON CLOUD COVER AT BAKER-NUNN OBSERVING SITES
Peter Brand and Leonard Solomon *In its* Res. in Space Sci. Some Results at Smithsonian Observing Sta. 17 May 1965 p 1–2 (See N65-31268 20-13) CFSTI: HC $2.00/MF $0.50

Statistics on the percent of satellite photography not attempted due to obscuring clouds are tabulated for 1962 and 1963. This is a lower level limit to the actual cloud cover hindrance, as occasional attempts at photography are made through thin or broken clouds. C.T.C.

N65-31270* Smithsonian Astrophysical Observatory, Cambridge, Mass.
RESIDUALS IN FIELD-REDUCED OBSERVATIONS
Leonard Solomon *In its* Res. in Space Sci. Some Results at Smithsonian Observing Sta. 17 May 1965 p 3–4 (See N65-31268 20-13) CFSTI: HC $2.00/MF $0.50

It is reported that field-reduced observations were compared with photoreduced observations and the orbits derived from them to determine the approximate error to be expected in any field-reduced observation. The differences between precisely-reduced and field-reduced residuals are tabulated and show that field-reduced accuracies are partially limited by chart accuracy. C.T.C.

N65-31271* Smithsonian Astrophysical Observatory, Cambridge, Mass.
PHOTOGRAPHY OF CHEMILUMINESCENT STUDIES OF UPPER ATMOSPHERE WIND PHENOMENA
John Mazzotta, Roy Proctor, and James Latimer *In its* Res. in Space Sci. Some Results at Smithsonian Observing Sta. 17 May 1965 p 5–23 (See N65-31268 20-13) CFSTI: HC $2.00/MF $0.50

New techniques are described for photographing rocket-released chemiluminescent trails used in studying upper atmosphere wind phenomena. Reports from different stations are presented which outline the techniques used, the problems encountered, and the suggested solutions for overcoming these problems. Details on sodium and trimethylene aluminum photography are tabulated. C.T.C.

N65-31273*# Chicago Univ., Ill. Dept. of the Geophysical Sciences.
A PROGRAM FOR COMPUTER GRIDDING OF SATELLITE PHOTOGRAPHS FOR MESOCALE RESEARCH
William D. Bonner Jun. 1965 34 p refs *Its* SMRP Res. Paper No. 43
(Grants NsG-333; CWB-WBG-6)
(NASA-CR-64324) CFSTI: HC $2.00/MF $0.50 CSCL 04A

A computer program is described which performs the coordinate transformations used in Fujita's graphical method for gridding TIROS photographs. Output is a matrix of picture coordinates of latitude-longitude intersections to be plotted on a distortion-free grid. Total time required to grid a series of photographs is greatly reduced compared to the original graphical technique. Author

N65-31487# Massachusetts Inst. of Tech., Cambridge. Geophysics Lab.
TWO-DIMENSIONAL CALCULATIONS OF MAGNETIC MICROPULSATION RESONANCES
Roy Jay Greenfield (Ph.D. Thesis) 21 Jun. 1965 147 p refs
(Contracts NR-371-401; AF 19(604)-7378)
(AD-618118)

Horizontal variations of magnetic micropulsation resonances were investigated using two-dimensional mathematical models. The first model simulates longitude independent propagation in a spherical earth ionosphere. The horizontal variation is introduced by the inclusion of a dipole magnetic field. Solutions were studied separately for daytime and nighttime ionospheric conditions. Results show that the lowest frequency vertical mode of the previous one-dimensional model is replaced by a series of resonant modes. The resonant frequencies of the lower order modes in the series are significantly separated because of the dipole magnetic field. The second model is cylindrical and its ionospheric parameters vary with the angular coordinate. Propagation is almost independent of the z coordinate and is representative of latitude independent propagation. Results show the continuous variation of the apparent period with local time which is in agreement with observations of actual micropulsations, and that the energy from a subsolar source is confined to the daytime hemisphere. Both models were solved using finite difference methods. R.N.A.

N65-31511# Johns Hopkins Univ., Baltimore, Md. Dept. of Mechanics.
SOLITARY WAVES IN THE WESTERLIES
Robert R. Long Jan. 1964 13 p refs
(Contract Nonr-4010(01); Grant WBG-21)
(TR-15(ONR); TR-18(WBG); AD-426416)

This paper contains a solution for a solitary disturbance in a westerly current on a β-earth. The current varies slightly with latitude and the existence of the phenomenon depends on this variation. The disturbance has a mathematical resemblance to the solitary water wave of Scott Russell. It is a single ridge if the current increases with latitude, and a single trough if the current decreases with latitude. The speed of propagation depends on the amplitude. Author

N65-31551# Gt. Brit. Dept. of Scientific and Industrial Research. Radio Research Station.
AN EXPLANATION OF VARIOUS IONOSPHERIC AND ATMOSPHERIC PHENOMENA INCLUDING THE ANOMALOUS BEHAVIOUR OF THE F-REGION
J. W. King, D. Eccles, A. J. Legg, P. A. Smith, P. A. Galindo et al Dec. 1964 96 p refs
(RRS/IM-191)

New studies, using data relating to both the topside and the bottomside of the ionosphere, indicate the existence of worldwide movements of regions in which the electron concentration is enhanced. It is shown that the production and movement of these "ionization maxima" may result from conventional horizontal F-region drifts. The movements of the ionization maxima are shown to be the cause of most of the major anomalies in the F-region, including the diurnal, seasonal, sunrise and possibly the equatorial anomalies. The maintenance of the nighttime ionosphere, many major ionospheric storm phenomena and also the universal time effects noticed in the ionosphere can be explained in terms of the observed horizontal movements of ionization. The moving ionization maxima in the F2-layer are shown to be associated with large travelling disturbances, sporadic-E ionization and possibly also with the F1-layer. Author

N65-31616# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Environmental Sciences Directorate.
SPECTRAL TRANSMISSIVITY OF THE EARTH'S ATMOSPHERE IN THE 250 TO 500 WAVE NUMBER INTERVAL. PART III: A METHOD OF EXPERIMENTALLY DERIVING TRANSMISSIVITY
James T. Hall, Charles W. Querfeld, Glenn B. Hoidale, and Ramon Mirelles Jun. 1965 25 p refs
(ERDA-315; AD-467000)

Experimental observations of the transparency of the earth's atmosphere in the 20 to 40 micron region of the far infrared were carried out at 111 feet below sea level, 10150 feet above sea level and 14250 feet above sea level. The resultant solar spectra were compared to the theoretically computed spectra using the Lorentz line shape and the tabulated half-widths, line strength and positions, with consideration given to the time-varying meteorological conditions that the radiation encountered in the slant path from the sun to the instrument. A method for determining transmissivity from the experimental data is derived by linearization of

$$E_\lambda(P) = E_\lambda(O) \exp\left[-k(\lambda) \int_0^p \omega dp\right]$$

where $E_\lambda(P)$ is the energy received by the measuring instrument at wavelength λ and $E_\lambda(O)$ is the source energy at this same wavelength. The total amount of precipitable water vapor in the zenith direction is given by

$$\int_0^p \omega dp \text{ and } k(\lambda) = \frac{d[\ln E_\lambda(P)]}{dW_\theta} \text{ letting } W_\theta \text{ equal the amount}$$

of precipitable water vapor in the slant path. Sample comparisons of the experimentally determined transmissivity and the observed spectra are shown. Author

N65-31623# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
A THREE FLUID MODEL IONOSPHERE
Craig Comstock Jun. 1965 150 p refs
(Contract Nonr-1866(20); Grant NSF GP-2226)
(TR-2; AD-618911)

This paper is intended as a contribution to the understanding of the distribution of particles in a planetary atmosphere

and the mechanisms responsible for maintaining that distribution. More particularly, we shall be concerned with model atmospheres which have relatively simple chemical compositions and which are ionized to some degree. Our primary interest shall be the distribution of particles throughout the atmosphere, the associated electric fields and the boundary conditions which are necessary to maintain the distributions. The problem considered here is to obtain some further insight into the mechanism which controls the distribution of particles in an ionosphere. In particular we shall be interested in the roles played by diffusion, the electric field and the boundary conditions. We shall derive a more general set of equations for the distribution of particles than has been previously published. We shall then apply this set of equations to a series of simple models, one of which is a reasonable model for the F layer of the Earth's ionosphere. Author

N65-31684# Aeronautical Chart and Information Center, St. Louis, Mo. Chart Research Div.
GEODESY FOR THE LAYMAN
R. K. Burkard Nov. 1964 99 p refs Revised
(AD-617530)

The use of intermediate and long range rockets and missiles requires that the distance and direction from launch site to target be accurately known. The science of geodesy can help to provide this information. The basic principles of geodesy and geodetic surveying are presented in an elementary form. The formation of geodetic datums is introduced and the necessity of connecting or joining datums is discussed. Methods used to connect independent geodetic systems to a single world reference system are discussed. Particular emphasis is placed on the contribution of the Air Force in developing a World Geodetic System. A chapter on Satellite Geodesy and an appendix on Spherical Harmonics have been added in the present edition. Author

N65-31730# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONNECTION OF BRIEF PERIODIC OSCILLATIONS (KPK) OF THE TERRESTRIAL ELECTROMAGNETIC FIELD WITH AURORA POLARIS ILLUMINATION INTENSITY VARIATIONS
R. G. Skrynnikov 2 Jul. 1965 18 p refs Transl. into ENGLISH from Issled. Geofiz. Yavleniy Elektromagnitn. Kompleksa v Vysokikh Shirotakh, Akad. Nauk SSSR, Kol'skiy Filial (USSR), 1964 p 29–38
(FTD-TT-65-112/1+2+4; AD-617683)

Observational data demonstrated a close relationship between illumination intensity variations of aurora polaris and brief periodic variations of the Earth's electromagnetic field. Presented are data on the diurnal process of aurora illumination intensity and the frequency of appearance of brief periodic oscillations (KPK) of the terrestrial electromagnetic field; the diurnal process of KPK in sip-type auroras and the electromagnetic field on calm days; and the diurnal process of splashes in aurora polaris and of KPK in perturbed electromagnetic fields. S.C.W.

N65-31737# New York Univ., N. Y.
ANALYSIS OF BREAKING ATMOSPHERIC WAVES
Arthur D. Ward (M.S. Thesis) Jun. 1965 47 p refs
(AD-617280)

The basic partial differential equations are derived for an atmospheric gravity wave at the internal interface of a two layer, incompressible model. The model has a parabolic, nonrotating lower boundary. These equations are numerically integrated by the method of characteristics for various values of two parameters which govern the shape of the parabolic lower boundary. An analysis is made for the effects of the modeling parameters on the point at which the wave begins to break. Author

N65-31792# Army Missile Command, Huntsville, Ala. Advanced Systems Lab.
SELECTED ATMOSPHERIC MODELS TO TWENTY-FIVE KILOMETERS FOR USE IN MISSILE SENSITIVITY STUDIES
Kathryn F. Gross and Richard E. Dickson 25 Jun. 1964 33 p refs
(RF-TN-64-6; AD-460828)

Equations and constants for computing atmospheric models derived from the U.S. Standard Atmosphere are presented. Deviation tables are given for the tropic mean, the temperate plus and minus one sigma, and the polar ,plus one sigma. The tables are based on one sigma temperature and density deviations which are not conformable. Therefore, the non-standard pressures have little statistical significance since they are computed directly from the gas laws. These tables are only for temperature–density sensitivity studies. A Fortran program for the IBM 1620 computer is included. R.N.A.

N65-31814# Colorado State Univ., Fort Collins.
ATMOSPHERIC STRUCTURE AND CLEAR-AIR TURBULENCE
Elmar R. Reiter and Anne Burns (RAE, Farnborough, England) Jun. 1965 17 p refs *Its* Atmospheric Sci. Tech Paper No. 65 Presented at the Intern. Colloq. on Fine-Scale Struct. of the Atmosphere, Moscow, 15–22 Jun. 1965

Measurements of clear-air turbulence spectra conducted by a Canberra aircraft over Australia between August and October 1963 reveal the existence of a wavelength region from approximately 2000 to 4000 ft, in which the atmosphere receives turbulent energy mainly in the w-component of motion. It is suggested that this energy stems from gravitational shearing waves which break up into turbulent eddies below a critical wave length. The energies of these turbulent eddies seem to be well represented by a proportionality to $\omega^{-5/3}$, characteristic of the inertial subrange of turbulence. Author

N65-31847# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
ANALYSIS OF THE OBSERVATIONAL CONTRIBUTIONS TO THE ERRORS OF THE NAVY SATELLITE DOPPLER GEODETIC SYSTEM
W. H. Guier, R. R. Newton, and G. C. Weiffenbach Jan. 1965 82 p refs
(Contract NOw-62-0604-c)
(TG-653; AD-464349)

This report analyzes the observational contributions to the total system error of the Navy's Satellite Doppler Geodetic System. Aside from the error imposed by the limited number of satellites available for analysis, which limits the complexity of the gravity field that can be used, it is concluded that the system error is about 10 meters for the observations from a single satellite pass, and is 5 meters or less for multiple passes. Author

N65-31901# Ionosphären-Institut Breisach (West Germany)
IONOSPHERIC DATA. VERTICAL ECHO SOUNDING. FREIBURG, OCTOBER, NOVEMBER, DECEMBER 1962 [IONOSPHAREN-DATEN. VERTIKAL-ECHO-LOTUNG. FREIBURG, OKTOBER, NOVEMBER, DEZEMBER 1962]
[1962] 119 p In GERMAN
(Rept.-196F; Rept.-197F; Rept.-198F)

Ionospheric characteristics are tabulated for the F2-layer, F1-layer, and E-layer for the last three months of 1962. Ordinary wave critical frequency is given for all three layers, for a transient stratification in the F-region, and for an occulting thick layer which sometimes appears between the normal E-layer and F1-layer. Lowest usable frequency showing vertical ionospheric reflections is tabulated as are minimum virtual height of the ordinary wave branch and virtual height of the ordinary branch at the frequency 0.834 foF2. Maximum usable frequency for a path of 3000 km for transmission by the F2-(F1-) layer is obtained by applying the standard transmission curve for 3000 km to the ordinary branch of F2-(F1-) trace.
M.W.R.

N65-31968# Hawaii Univ., Honolulu. Hawaii Inst. of Geophysics.
EXPERIMENTAL AND THEORETICAL STUDY OF TERRESTRIAL AND PLANETARY ATMOSPHERES Final Report, 1 Feb. 1962–31 Mar. 1965
Kenichi Watanabe 15 Apr. 1965 93 p refs
(Contract AF 19(629)-265)
(AFCRL-65-307; AD-617519)

Using improved resolution of 0.2 to 0.4 A and photoelectric techniques, attempts were made to obtain more detailed curves of absorption coefficients of several gases. The Hopfield helium continuum was used in the 580-1000 A region and the H_2 emission source for longer wavelengths. Ionization yields were obtained with nitric oxide and xenon ion chambers. Absorption and photoionization coefficients of NH_3 from 580 to 1650 A, CO_2 from 580 to 1670 A, NO from 580 to 1100 A, H_2 from 600 to 840 A, and COS from 1065 to 1130 A are presented. Absorption bands and continua, ionization potentials, and preionization are discussed.
Author

N65-32009# Institut Royal Météorologique de Belgique, Brussels.
SOLAR RADIATION IN UCCLE, 1956 [RAYONNEMENT SOLAIRE A UCCLE, ANNEE 1956]
1965 67 p refs In FRENCH *Its* Publ. No. 52, Ser. A

Solar radiation measurements made in Belgium during several months in 1956 are tabulated. The data consist of heliograph observations of the duration of insolation, and determinations of the amount of heat per square meter due to the radiation perpendicular to a normal surface.
Transl. by J.M.D.

N65-32028*# California Univ., Livermore. Lawrence Radiation Lab.
MEASUREMENTS AT THE SOUTHERN MAGNETIC CONJUGATE REGION OF THE FISSION DEBRIS FROM THE STARFISH NUCLEAR DETONATION
Raymond G. D'Arcy and Stirling A. Colgate 11 Sep. 1964 36 p refs Prepared in part at Chicago Univ.
(Grant NsG-179-61; Contracts W-7405-ENG-48; AF 19(604)-4554)
(NASA-CR-64573; UCRL-12056) CFSTI: HC $2.00/MF $0.50 CSCL 18C

The fission products from the July 9, 1962, 'Starfish' high-altitude nuclear detonation have been measured with a recording gamma-ray spectrometer near the southern magnetic conjugate point of the Starfish location. The transit time of 2 to 20 sec over the 4000-km flight path indicates that debris arrived both noninteracted and interacted with the earth's atmosphere at the point of detonation. Since the southern magnetic conjugate point is below the horizon relative to the detonation point, all measured debris must have been ionized and guided by the geomagnetic field. The large fraction of debris observed (~50%) indicates the dominance of the geomagnetic field interaction. The spatial distribution of debris indicates that the major fraction arrived on the flux tube (~300 km width, flux surface L = 1.12) conjugate to the detonation point with a 2° westward drift. Additional debris was observed distributed southward up to L = 1.29 indicating a partial penetration across the flux surfaces of the geomagnetic field. The injection of high energy electrons into trapped orbits around the earth is identified with the beta decay in transit of the observed debris.
Author

N65-32037*# International Business Machines Corp., Rockville, Md. Federal Systems Div.
SPECIAL AROD SYSTEM STUDIES First Quarterly Report 15 Oct. 1963 131 p
(Contract NAS8-11050)
(NASA-CR-64539; IBM-TR-23-099) CFSTI: HC $4.00/MF $1.00 CSCL 08E

A computer interface investigation and an oceanborne transponders analysis are presented as part of a continuing study of the special Airborne Range and Orbit Determination (AROD) system. A detailed derivation of the equations necessary to convert the basic AROD measurements, range, and range rate to position and velocity provides the foundation for a preliminary determination of the computer requirements for all AROD computations. Based on the characteristics of the advanced Saturn computer, a computation time of 0.2 ± .1 seconds was estimated for the AROD operations. A launch trajectory error analysis presents an extensive evaluation of the geometrical dilution of precision associated with the use of AROD in the Atlantic Missile Range. An AROD computer interface discussion outlines an approach to the implementation of this interface and discusses some unresolved issues. A preliminary analysis of the specific problem areas involved in the establishment of a network of oceanborne transponders is presented. Emphasis is on the use of taut line mooring and/or acoustic ranging equipment to keep a transponder carrying buoy stationary. Design consideration for such buoys are discussed.
R.N.A.

N65-32038*# International Business Machines Corp., Rockville, Md. Federal Systems Div.
SPECIAL AROD SYSTEM STUDIES Second Quarterly Report 15 Jan. 1964 125 p
(Contract NAS8-11050)
(NASA-CR-64540; IBM-TR-23-110) CFSTI: HC $4.00/MF $1.00 CSCL 08E

The principal result of the computer requirements effort is an estimate of requirements for basic and auxiliary computations. The estimates, based on the characteristics of the Saturn V guidance computer and data adapter, for all AROD (Airborne Range and Orbit Determination)-related computation time and storage requirements are 0.15 seconds and 1500 data word locations. An effort was directed towards optimizing the AROD sensor extraction elements to the Saturn V guidance system. The principal conclusion concerns the desirability of providing a continuous doppler readout capability. Geometrical dilution of precision associated with a translunar orbit injection, effects of transponder geometry on system errors, and effects of transponder survey errors were investigated. The material on oceanborne transponders deals with the limitations of existing buoy designs in the environments and conditions that exist in the ocean region of interest. Their inability to meet the position keeping and stability requirements that are desirable for AROD are shown.
R.W.H.

N65-32054# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SYNCHRONOUS OBSERVATIONS OF MAN-MADE EARTH SATELLITE ECHO-1 FOR GEODETIC PURPOSES
D. Ye. Shchegolev, A. G. Masevich, and B. G. Afanas'yev 30 Jun. 1965 11 p Transl. into ENGLISH from Vestn. Akad. Nauk SSSR (Moscow), no. 7, 1964 p 74–77
(FTD-TT-65-313/1+2+4; AD-617676)

The principle of geodetic triangulation using satellites is discussed. The method of cosmic triangulation by synchronous observations of Earth satellites appears to offer unique opportunities of obtaining electrophotographic representations of inaccessible regions of the earth. Also, the method opens broad possibilities for international cooperation in defining the coordinates of islands and other points of importance for sea navigation. E.E.B.

N65-32066# Bureau of Mines, Washington, D. C.
STATISTICAL ANALYSIS OF GAMMA-RAY LOG SAMPLE DATA FROM A URANIUM DEPOSIT, AMBROSIA LAKE AREA, MCKINLEY COUNTY, N. MEX.
George R. Schottler 1965 55 p refs
(BM-RI-6645)

The objective of this research is to find the extent of the range of applicability of previously developed statistical methods for determining grade and tonnage of ore to bedded uranium deposits. Uranium assays obtained from gamma-ray logs of exploratory drill holes are used to compute grade and tonnage of ore in the deposit by a standard polygonal method and by statistical analysis. The results obtained by the two methods are compared. The uranium-assay frequency distributions are shown to be lognormal and a simple transformation permits the use of standard normal curve statistics. The effects on the assay frequency distributions of stratified sampling, a required minimum mining thickness, and increased assay-interval length are investigated. The addition of low-grade mineralization to make up the required minimum mining thickness results in a distinct change in the skewness of the assay frequency distribution. Any statistical inference regarding grade-tonnage relationships that will be produced, using the minimum mining thickness, should be made on the basis of this "revised" assay frequency distribution. Author

N65-32083*# New Hampshire Univ., Durham. Dept. of Physics.
PRELIMINARY RESULTS OF MEASUREMENTS OF SQ CURRENTS AND THE EQUATORIAL ELECTROJET NEAR PERU
N. C. Maynard and L. J. Cahill, Jr. [1965] 11 p refs
(Contract NAS5-3043)
(NASA-CR-64431) CFSTI: HC $1.00/MF $0.50 CSCL 04A

Data obtained from Nike-Apache sounding rockets used to measure electrical currents in the ionosphere are reported. The rockets were also instrumented to measure the magnetic field and the electron density. A nuclear free precession magnetometer measured the scalar magnitude of the earth's magnetic field, and a dc Langmuir probe was used to measure the relative electron density. Also included in the payload for trajectory and aspect determinations were a barometric pressure switch, an ionization chamber densitometer to monitor air pressure, and a magnetic aspect sensor. C.T.C.

N65-32094*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RESEARCH WITHIN THE ATMOSPHERE
Robert F. Bourdeau [1964] 34 p refs Submitted for Publication
(NASA-TM-X-54818) CFSTI: HC $2.00/MF $0.50 CSCL 04A

Satellite observation data showed that the transition between the F region and the upper ionosphere is from O^+ to He^+ and then to H^+ as the altitude increases. The thickness and altitude of the helium ion region decrease drastically from day to night. Helium ions are never dominant during nighttime conditions, and during the year of minimum solar activity. Some evidence was found that the ion temperature in the upper ionosphere is controlled by the electron temperature which exhibits a complicated diurnal and latitudinal behavior. It was concluded that theoretical models of the F region, the upper ionosphere, and the interdependence of these two regions should be updated by correlations with measurements of photoelectrons and fast particle fluxes. G.G.

N65-32095*# New York Univ., N. Y. Dept. of Chemistry.
THEORETICAL STUDY OF ATOMIC AND MOLECULAR GASES AND THEIR REACTIONS IN THE UPPER ATMOSPHERE Summary Report, 1 Nov. 1963–30 Apr. 1964
Roop C. Sahni [1964] 8 p refs
(Grant NsG-76-60)
(NASA-CR-58322) CFSTI: HC $1.00/MF $0.50 CSCL 04A

In a project directed toward computation of the electronic states of diatomic molecules, the calculations were extended to include the 3s and 3p orbitals. Values are presented for the total energies of the electronic states of molecular oxygen and nitrogen. Total energies are also tabulated for ionized and excited states of numerous hydrides in atomic units. Modification of computer programs to obtain these data is described. J.M.D.

N65-32098*# Chicago Univ., Ill. Enrico Fermi Inst. for Nuclear Studies.
ON THE ORIGIN OF THE CANYON DIABLO NO. 2 AND NO. 3 METEORITES
Dieter Heymann Jul. 1964 13 p Submitted for Publication
(Grant NsG-366)
(NASA-CR-58416; COO-382-48; EFINS-64-38) CFSTI: HC $1.00/MF $0.50 CSCL 08D

Measurements of He^3, Ne^{21} and Ar^{38} in nine Canyon Diablo meteorites indicate that the "anomalous" Canyon Diablo No. 2 was located inside the main mass of Canyon Diablo "No. 1" when the latter struck the atmosphere. Canyon Diablo No. 3 probably originated from the main mass too, but the evidence is less certain. These conclusions speak against the view that the anomalous Canyon Diablo irons were either satellites of the main mass or distinct falls. It appears instead that significant chemical and structural variations existed in the nickel–iron phase of the meteorite parent body over distances of some tens of meters. Author

N65-32118*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A NIGHT-TIME MEASUREMENT OF OZONE ABOVE 40 KM
Edith I. Reed and Reuben Scolnik [1964] 29 p refs Submitted for Publication
(NASA-TM-X-54801) CFSTI: HC $2.00/MF $0.50 CSCL 04A

The ozone distribution between 40 and 70 km was measured near midnight, May 27, 1960, from Wallops Island, Virginia by means of photometers sensitive to the ultraviolet airglow at wavelengths between 2400 and 2900 A. Below 60 km, the densities are within a factor of two of the daytime photo-chemical equilibrium, as represented by Johnson's late afternoon measurement of June 14, 1949. Above 60 km, the ozone density increased with altitude, with its maximum increase, a factor of 6 over the day time value, occurring at 63 km. Author

N65-32119*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

A DETERMINATION OF EARTH EQUATORIAL ELLIPTICITY FROM SEVEN MONTHS OF SYNCOM II LONGITUDE DRIFT

C. A. Wagner [1964] 5 p refs Submitted for Publication

(NASA-TM-X-54802) CFSTI: HC $1.00/MF $0.50 CSCL 08E

From observations of the 24-hour Syncom II satellite it is shown that J_{22} (adjusted for probable higher order earth gravity effects) $= -(1.9 \pm 0.2) \times 10^{-6}$ where J_{22} is the amplitude of the first significant longitude dependent term in the spherical harmonic expansion of the earth gravity potential. It is related to the difference between major and minor earth equatorial radii by $a_0 - b_0 = -6R_0J_{22}$ where R_0 is the mean equatorial radius of the earth and a_0 is the semi-major axis of the 24-hour satellite. It is also shown that $a_0 - b_0 = 73 \pm 8$ meters which is the difference in major and minor equatorial radii at 21 ± 7° west of Greenwich. Unless the earth is far more inhomogeneous than is thought to date, these estimates can be considered the absolute bounds of the ellipticity of the equator. E.E.B.

N65-32122*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

EXPERIMENTAL CONTROL OF OXYGEN FUGACITIES BY GRAPHITE-GAS EQUILIBRIA

Bevan A. French and Hans P. Euester [1964] 38 p refs Submitted for Publication

(NASA-TM-X-54821) CFSTI: HC $2.00/MF $0.50 CSCL 06D

Control of oxygen fugacities in a $CO_2 + CO$ atmosphere has been established experimentally by using a solid-phase buffer technique. Equilibration between the buffer and the enclosed sample is established by diffusion of the gas atmosphere through the buffer. The establishment of equilibrium by this method is indicated by the reversibility of experimental results in a study of the decomposition relations of siderite, $FeCO_3$. Precipitation of solid graphite from a $CO_2 + CO$ atmosphere under reducing conditions provides a method for control of f_O values through equilibrium between crystalline graphite and the oxides of carbon in the gas phase. Equilibrium values of f_O are calculated from thermodynamic data for several values of $P_{gas} = P_{co_2} + P_{co}$. For values of P_{gas} greater than 100 bars, the following approximation may be used without serious error:

$$\log f_{O_2} = -\frac{20\,586}{T} - 0.044 + \log P_{gas} - 0.028\frac{(P_{gas} - 1)}{T}$$

Author

N65-32139# Ohio State Univ., Columbus.

CHANGES IN THE GEODETIC COORDINATES DUE TO A CHANGE IN THE REFERENCE ELLIPSOID

John Charles Herring (M.S. Thesis) 1965 97 p refs Sponsored by AF

(AD-617296)

Projection methods were investigated for computation of the changes in the geodetic latitude and longitude due to changes in the size or orientation of the reference ellipsoid. The Vening Meinesz equations, space rectangular coordinate method, Baldini equations, and isoparametric method were the projection method formulas evaluated. The complete derivation is given for the Baldini equations and the space rectangular coordinate method. Each set of equations is programmed so that the computations could be performed on a computer, and the program used for the Baldini equations is described in detail. C.T.C.

N65-32151*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

A DETERMINATION OF EARTH EQUATORIAL ELLIPTICITY FROM SEVEN MONTHS OF SYNCOM II LONGITUDE DRIFT

C. A. Wagner [1964] 6 p refs Submitted for Publication

(NASA-TM-X-54813) CFSTI: HC $1.00/MF $0.50 CSCL 08E

Longitude drift and drift acceleration is analyzed for the Syncom II satellite using range and range rate radar and minitrack radio interferometer data gathered over a seven month period. Simulated Syncom II trajectories for the periods of apparent drift support the hypothesis of an earth gravity field with longitude dependence; other suggested factors, such as sun and moon influence or earth zonal gravity influence, do not account for the drift phenomena. Harmonic analysis is reported which also serves to validate the hypothesis. J.M.D.

N65-32163*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

A LATITUDE SURVEY OF THE NIGHT AIRGLOW

T. N. Davis and L. L. Smith (Natl. Bur. of Stds., Boulder, Colo.) [1964] 29 p refs Submitted for Publication

(NASA-TM-X-54815) CFSTI: HC $2.00/MF $0.50 CSCL 04A

A four-color turret photometer has been used for shipboard observations of the night airglow and the aurora. Zenith observations have been obtained during 1962 close to the 70° W meridian from the northern auroral zone to the Antarctic pack ice. Most of the observations were taken during the Southern Winter. Maximums in the [OI] 5577A intensity were found 30–40° N and 40° S, with the Southern Hemisphere level being generally lower than that in the Northern Hemisphere. The [OI] 6300A latitudinal variation was similar to that of [OI] 5577A except that maximums in the latitudinal distribution were found near 15° geomagnetic north and south latitudes. In contrast with the [OI] emissions, the sodium group (NaD doublet and OH bands near 5893A) generally increased to the south with maximums near 20–30° N and 40–50° S geographic latitude. The total 5340A background increased from north to south. When the integrated starlight and zodiacal light components were subtracted from the total background, the resultant terrestrial component showed a pronounced minimum at low latitudes and apparent symmetry about the geomagnetic equator. Author

N65-32189# Danish Meteorological Inst., Charlottenlund.

DETERMINATION OF CONSTANTS OF A SPECIAL MAGNETOGRAPH RUN AT GODHAVN GEOPHYSICAL OBSERVATORY, PERIOD 1960–1963 Scientific Report No. 1

Knud Lassen 26 Feb. 1965 30 p

(Contract AF 61(052)-507)

(AFCRL-65-510; AD-619293)

This report concerns the determination of formula and baseline values for the period January 1, 1960 to December 31, 1963 for the H-magnetograph run at Godhavn Geophysical Observatory. Besides bringing the formula and constants necessary for a further study of the magnetograms the report shows the existence of a regular yearly variation of the baseline values nearly in phase with the variation of the air temperature at Godhavn. Since the magnetograph is kept at a constant temperature in a well insulated shelter it is assumed that the dependence on the variation of the outdoor temperature is an indirect one, probably a dependence on the variation of the humidity in the shelter. Author

N65-32201# General Electric Co., Philadelphia, Pa. Space Sciences Lab.
RESEARCH DIRECTED TOWARD AN INVESTIGATION OF THE CHEMICAL KINETICS OF ATMOSPHERE DEIONIZATION Final Report
M. H. Bortner Apr. 1965 37 p refs *Its* Rept.-214–218F (Contract AF 19(628)-4153)
(AFCRL-65-392; AD-619253)

The chemical kinetics of the deionization of a highly ionized atmosphere has been considered. Reaction rate constants are suggested for each of the many reactions considered. These suggested values are believed to be the best presently available but it is realized that lack of available data introduces much uncertainty in the values. Author

N65-32209# General Electric Co., Philadelphia, Pa. Space Sciences Lab.
A STUDY OF THE REFLECTION AND POLARIZATION CHARACTERISTICS OF SELECTED NATURAL AND ARTIFICIAL SURFACES
K. C. Coulson, E. L. Gray, and G. M. Bouricius May 1965 150 p refs
(Contract N123(60530)51172A)
(R65SD4; AD-619032)

This report covers two aspects of the short wave regime of planetary radiation. First, extensive measurements of the reflection properties of a number of surfaces have been made, both the directional reflectance and the degree of polarization of the reflected radiation having been determined. It is found that most surfaces show pronounced "limb-brightening" for large angles of incidence, while for small angles of incidence the reflectance does not vary greatly with angle at which the surface is viewed. The second part of the research has been the introduction of the reflectance values into the theory of radiative transfer to determine the characteristics of the radiation field at high altitudes above the surface. It is seen that for the cases of clear and slightly turbid atmospheres the surface properties have a strong influence on the contrasts which would be observed from a high altitude vantage point. Author

N65-32246# Library of Congress, Washington, D. C. Aerospace Technology Div.
ON THE MEASUREMENT OF THE X-, Y-, AND Z-COMPONENTS OF THE GEOMAGNETIC FIELD ON SATELLITES AND ROCKETS [OB IZMERENII X-, Y-, Z-SOSTAVLYAYUSHCHIKH GEOMAGNITNOGO POLYA NA SPUTNIKAKH I RAKETAKH] Translations of Soviet-Bloc Scientific and Technical Literature
A. D. Shevnin 26 Jul. 1965 12 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 3, no. 2, 1965 p 231–236
(ATD-T-65-55; AD-618465)

The feasibility of measuring the X-, Y-, and Z-components of the geomagnetic field on satellites triaxially oriented relative to the center of the earth and on unoriented objects is investigated. The northern X-, eastern Y-, and vertical Z-components of the field intensity can be obtained conveniently by rocket and satellite and compared with terrestrial measurements of the geomagnetic field. This can be accomplished only when the field intensity vector is given by three angles relative to the plane of the orbit or the earth–object–sun plane. It is observed that the accuracy of orientation is apparently low for magnetic measurements of the components. For a satellite with uniaxial orientation and for an unoriented satellite, the installation of the position indicators of the sun and earth is required. The bearing of the sun can be made with an accuracy of 0.1° and with infrared light the local vertical may be determined within 0.3°. Thus, a satellite with uniaxial orientation with the local vertical is more convenient for magnetic measurements since the requisite accuracy in measuring angles can be achieved and the calculations are not difficult. E.E.B.

N65-32262*# National Aeronautics and Space Administration, Washington, D. C.
NEW OBSERVATIONS OF THE RED LINE OF THE SKY AT NIGHT IN AFRICA
D. Barbier Aug. 1965 24 p refs Transl. into ENGLISH from Ann. Geophys. (Paris), v. 20, no. 1, 1964 p 22–33
(NASA-TT-F-8758) CFSTI: HC $1.00/MF $0.50 CSCL 04A

Observations of the red line of the night airglow have been simultaneously made in Tamanrasset (Algeria) and Agadez (Republic of Niger) from October 18th to November 3d, 1965. The altitude of the intertropical arc, deduced from triangulations, remained between 235 and 280 km. The structure of the arc has been investigated, together with its movement during the night. The correlation between the air-glow phenomena and the structure of the atmospheric F layer has been more throroughly considered than before. The recombination coefficient is very small in the F layer: the structure of this layer is controlled by the plasma movements. Author

N65-32263*# National Aeronautics and Space Administration, Washington, D. C.
PRIMARY CRYSTALLIZATION OF MINERALS AND STRUCTURE OF METEORITE CHONDRULES [PERVICHNAYA KRISTALLIZATSIYA MINERALOV I STRUKTURY METEORITNYKH KHONDR]
D. P. Grigor'yev Aug. 1965 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 156, no. 6, 1934 p 1355–1357
(NASA-TT-F-8761) CFSTI: HC $1.00/MF $0.50 CSCL 08G

The structures of meteorite chondrules are determined by a combination of initial mineral crystallization, their deformation, and their subsequent recrystallization. The minerals in chondrules form only in structures of plate-like or needle-like spherulites; other structures are not characteristic of natural bodies but rather of artificial preparation methods like polishing, etc. Dispherulitic and polysperulitic chondrules contain formations of two or more incomplete eccentric spherulites with plates or needles meeting at the border between the spherulites, or sprouting out mutually in an open lattice pattern. G.G.

N65-32264*# National Aeronautics and Space Administration, Washington, D. C.
PARAGENETIC ANALYSIS OF CARBONACEOUS ROCKS WITH SPURRITE–MERWINITE FACIES [PARAGENETICHESKIY ANALIZ KARBONATNYKH POROD SPURRITMERVINITOVOY FATSII]
V. V. Reverdatto Aug. 1965 28 p refs Transl. into ENGLISH from Geol. i Geofiz., Akad. Nauk SSSR, Sibirsk. Otd. (Novosibirsk), no. 2, 1965 p 3–20
(NASA-TT-F-8768) CFSTI: HC $2.00/MF $0.50 CSCL 08G

An analysis is made of the paragenetic relationships of mineral carbonaceous rocks metamorphosed under high temperature and low pressure conditions in contacts of subigneous intrusions, chiefly of basic composition. The division of spurrite–merwinite sub-facies is based on two facies: the merwinite–calcareous, high temperature facies, and the monticellite–spurrite–tilleyite facies of relatively lower temperature. Author

N65-32274*# National Aeronautics and Space Administration, Washington, D. C.

SOME POSSIBILITIES OF DETERMINING WIND VELOCITY OVER THE OCEAN SURFACE BY SATELLITE OBSERVATIONS [O NEKOTORYKH VOZMOZHNOSTYAKH OPREDELENIYA SKOROSTI VETRA NAD OKEANICHESKOY POVERKHNOST'YU PO NABLYUDENIYAM ISKUSSTVENNYKH SPUTNIKOV ZEMLI]

G. V. Rozenberg and Yu.-A. R. Mullamaa Aug. 1965 20 p refs Transl. into ENGLISH from Fiz. Atmosfery i Okeana (USSR), v. 1 no. 3, 1965 p 282-290

(NASA-TT-F-9531) CFSTI: HC $1.00/MF $0.50 CSCL 04A

The wind velocity at the near-water surface layer from the solar or lunar path observed from great altitudes is discussed. It was formulated that if the water's surface is illuminated by direct rays of the sun or moon, and clouds do not shield it from the observer, it is then possible to determine wind velocity and direction by measuring the brightness characteristics of the sun or moon path on the surface of the water. Correlation factors with wind velocity determined experimentally show that the average error of determining wind velocity from the known distribution function of inclination with respect to orientation is about ±1 m/sec. R.W.H.

N65-32292# London Univ. (England). Dept. of Physics.

DETERMINATION OF AIR DENSITY, TEMPERATURE, AND WINDS AT HIGH ALTITUDES Annual Summary Report No. 1

R. W. Procunier, G. V. Groves, and D. P. Mc Dermott 1 Mar. 1965 46 p refs *Its* Sci. Rept.-2

(Contract AF 61(052)-781)

(AFCRL-65-432; AD-618301)

Progress is reported on the development of acoustical detection of signals from grenade releases above 85 km altitude and on the development of the theory of acoustical propagation through the atmosphere for the purpose of grenade burst position triangulation. A review of meteorological conditions pertinent to wind noise considered thermal and mechanical production of large scale and dissipation of small scale turbulence. In the rocket-grenade experiment a wind and temperature structure for the upper atmosphere was derived from measurements of the travel time of a shock wave from a grenade explosion to a microphone array at ground level. Also, a theory of triangulation is presented for trajectory prediction from known points obtained by acoustical triangulation of low altitude grenade bursts. E.E.B.

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N65-31274# Texas Univ., Austin. Defense Research Lab.

[DESIGN AND CALIBRATION OF INSTRUMENTATION FOR SEISMIC RESEARCH] Quarterly Status Report, 1 Apr.-30 Jun. 1965

D. W. Evertson and G. E. English 3 Aug. 1965 31 p ref

(Contract CGS-1198)

(DSR-6)

A calibration system using an electromagnetic shaker has been installed in the solion universal (cylindrical bodied) seismometer and tested. A visit was made to the Seismic Laboratory at Albuquerque, New Mexico, to discuss the units to be supplied by Defense Research Laboratory (DRL) in this contract year. Some comparative recording with solion seismometers was done at that time. A better recording site for seismic testing is now being used at the Balcones Research Center, The University of Texas, Texas. Additional shaketable testing was done at the Geotechnical Corporation, Garland, Texas. The new testing facility there was found to be quite noisy. All indications are that the solion universal seismometer is superior to the open-frame type with regard to spurious noises. Author

N65-31344 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE INFLUENCE OF TEMPERATURE OF A MEDIUM ON READINGS OF A SCINTILLATION COUNTER

Ye. L. Stolyarova, L. Ch. Soldayeva, and G. M. Shuchkov *In its* Instrs. and Methods of Radiation Analysis 4 Mar. 1965 p 145-159 refs (See N65-31329 20-24)

The temperature influence of various media on photomultipliers was investigated. Box shaped photomultipliers with floating dynodes of Cu, Al, or Mg showed a maximal dependence of the signal amplitude on the temperature at −10° to +20° C. Trough-shaped photomultipliers with antimony-cesium dynodes increased their signal amplitude with temperature increase above room norm; and louver type photomultipliers with alloy dynodes (CuAlMg) did not show any temperature dependence due to the absence of strong focusing. Experiments with scintillation counters in combination with organic (stilbene, naphthalene, and tolane), and inorganic (NaI (T1), CsI (T1), and KI (T1)) crystal scintillators activated by Cs^{137} found only a weak linear dependence of the temperature to signal amplitude ratio for the KI (T1) crystal. A combination scintillation photomultiplier counter with a KI (T1) crystal was insensitive to temperature changes from −50° C to +50° C with an accuracy of up to 10 percent. Combinations of photomultipliers with NaI (T1), or Cs (T1) scintillators were not sensitive to temperature changes from −10° C to +50° C. G.G.

N65-31345 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ADJUSTMENT AND CALIBRATION OF LONGITUDINAL MAGNETIC BETA SPECTROMETER

V. F. Baranov, I. M. Dmitriyevskiy, and B. G. Titov *In its* Instrs. and Methods of Radiation Analysis 4 Mar. 1965 p 160-168 refs (See N65-31329 20-24)

Described is the construction of a magnetic air-core lens beta spectrometer, and a schematic longitudinal cross section of the apparatus is shown. Calibration of the spectrometer was executed by maxima of the K and L-lines from Cs^{137} electron conversion, with the maximum of the K-line (H_p = 3381 oersted · cm) corresponding to a current through the lens I = 2.491 ±0.002 a. A calibration curve from the beta spectrum of P^{32} and the spectrum of photoelectrons, knocked out by gamma rays of Hf^{181} from a bismuth converter of 3 milligram/cm^2 thickness, established a linear dependence with an angular coefficient of 1359 ±3 oersted cm/a. G.G.

N65-31349# California Univ., Livermore. Lawrence Radiation Lab.

ELECTRONIC INSTRUMENTATION SYSTEMS FOR NUCLEAR EXPLOSION DIAGNOSTICS

M. Mc Craven and G. Longerbeam May 1964 13 p refs
(Contract W-7405-ENG-48)
(UCRL-7791, Sum.)

Diagnosis of the phenomena occurring during the detonation of a nuclear explosive requires: (1) radiation detectors that convert many forms of energy (neutrons, gamma, visible light, X-rays) into electrical voltage pulses; (2) transmission links for transferring these electrical signals to a safe distance; (3) oscillograph and digital systems for recording and processing the transmitted data. The extremely short times and tremendous dynamic ranges involved create problems which require unique electronics equipment for their solution. This paper presents a panoramic view of these equipment developments and discusses: (1) their assimilation into an over-all system; (2) the calibration and operation of this system; and (3) future development projects and problems. Author

N65-31416 Compagnie d'Applications Mecaniques a l'Electronique au Cinema et a l'Atomistique, Paris (France).
A NEW RAPID SCANNING DEVICE OF ELECTRONIC MICROSCOPY FOR THE CAMERA MICROPROBE [NOUVEAU DISPOSITIF DE MICROSCOPIE ELECTRONIQUE PAR BALAYAGE RAPIDE ADAPTABLE A LA MICROSONDE CAMECA]
C. Conty *In* EURATOM On Electron Microprobe Analysis—Quant. and Structural Analysis of Nucl. Mater. Jun. 1964 p 187–195 In FRENCH (See N65-31404 20-06) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 250 Belg. Fr.

An electron microscope is proposed which is based on the principle of electron absorption. In this microscope the electronic image is determined by the amount and distribution of electrons captured by the specimen during rapid scanning. The resulting image is displayed on an oscilloscope. The resolution limit of the microscope is better than one micron. This technique can also be used to obtain X-ray images of extremely small areas for which spectrometric defocalization can be tolerated. Transl. by J.M.D.

N65-31442# Hanford Atomic Products Operation, Richland, Wash.
RECENT ACCOMPLISHMENTS IN NONDESTRUCTIVE TESTING RESEARCH AT HANFORD LABORATORIES
G. F. Garlick 16 Jul. 1964 28 p Presented at the AEC Nondestructive Testing Symp., Argonne Natl. Lab., Ill., 22–24 Jul. 1964
(Contract AT(45-1)-1350)
(HW-SA-3578; CONF-784-1)

Various nondestructive methods for testing nuclear reactor equipment are described. An electromagnetic testing device was developed for detecting flaws in heat exchanger tubing in a steam generator. To extract information from eddy current testing, a multiparameter test was devised that used signal analysis to separate and measure individual test specimen parameters. Eddy current testing was successfully applied in detecting hydride concentration in Zircaloy reactor process tubing. A heat transfer technique for locating cracks and unbonds, with reduced sensitivity to variation in surface conditions, was applied to aluminum clad fuel elements. A testing method in which ultrasonic waves are propagated at liquid-solid interfaces is described. J.M.D.

N65-31480# Catholic Univ. of America, Washington, D. C. Div. of Nuclear Science and Engineering.
FEASIBILITY OF A SHORT-LIVED RADIOISOTOPE TRACER SYSTEM FOR DETECTION OF HIDDEN MATERIALS
E. D. Jordan Washington, AEC, Dec. 1964 58 p refs
(Contract AT(30-1)-2586)
(NYO-2586-2) CFSTI: $3.00

The feasibility of detecting hidden materials by the addition of low activity radioactive tracers was investigated. All gamma emitting isotopes with half-lives between 5 and 36 hours were considered with As^{76}, Cu^{64}, Eu^{152m}, Pr^{142}, Na^{24} and W^{187} investigated in detail because of their gamma emission spectra and neutron absorption cross section. Neutron irradiator systems using isotopic neutron sources and a reactor source of neutrons were investigated. Several systems using a radioisotope generator for producing short-lived isotopes were investigated but none produced an isotope meeting half-life and gamma ray energy requirements. A portable radiation detection probe with sodium iodide crystal, amplifier, power supply, and transmitter was designed. A reactor was used to irradiate europium nitrate impregnated samples. A 50 microcurie source was detected more than 4 feet away with a signal to background ratio of 5. Consideration was given to safety and licensing problems in the use of radioactive tracers in the postal system. R.N.A.

N65-31588# Alabama Univ., University. Bureau of Engineering Research.
A THEORETICAL STUDY TO IMPROVE UTILIZATION OF MISSILE TELEMETRY SYSTEMS Final Report, 11 Apr. 1962–10 Jan. 1963
Richard S. Simpson and J. Reese Burnett Feb. 1963 52 p refs
(Contract DA-01-009-ORD-1041)
(AD-468427)

Data bandwidth compression systems are compared with respect to significant hardware factors, compression ratios, and overall performance for improving the utilization of telemetry bandwidth in missile telemetry systems. Compression systems using band-type, zero-crossing, and coherent memory-filter analyzers were evaluated. The major difficulty is the extraction of information from raw data which will give the power density spectrum. Only the band-type analyzer appears to be feasible under the strict hardware limitations imposed on non-tactical systems. Also given is an example of a priority switching circuit along with the circuit diagram. L.S.

N65-31648*# National Aeronautics and Space Administration, Washington, D. C.
STEREOSCOPIC FILMING OF RAPID PROCESSES BY TWO INDEPENDENTLY OPERATING MOVING PICTURE CAMERAS [STEREOSKOPICHESKAYA S'YEMKA BYSTROPROTEKAYUSHCHIKH PROTSESSOV DVUMYA NEZAVISIMO RABOTAYUSHCHIMI KINOKAMERAMI]
V. V. Garnov and A. S. Dubovik Sep. 1965 10 p refs Transl. into ENGLISH from Zh. Nauch. i Priklad. Fot. i Kinematografii (Moscow), v. 9, 1964 p 116–121
(NASA-TT-F-337) CFSTI: $1.00 CSCL 14E

A stereoscopic filming method is presented for producing stereoscopic pairs, within a certain allowable time period of desynchronization, by two cameras, each working independently. The size of the exposure base, therefore, is of no consequence as each camera has no direct connection with the other. Accuracy of frame synchronization depends on the parameters of filming. Due to the operation of two cameras with different frequencies of exposure there occurs a superpositioning of frame exposures—"frequency pulsations." Soil dispersion caused by subterranean explosions is described as investigated by this method. Fulfillment of the conditions of this simultaneous exposure of frames depends on the stability of frequency exposure and for good results it is necessary to maintain exposure frequencies of an accuracy of ~1%. Author

N65-31650# Joint Publications Research Service, Washington, D. C.
IZVESTIYA VUZOV: INSTRUMENT BUILDING, VOL. VIII, NO. 3, 1965
S. I. Zilitinkevich, ed. 19 Aug. 1965 151 p refs Transl. into ENGLISH of Izv. Vysshikh Uchebn. Zavedeniy, Priborostr. (Leningrad), v. 8, no. 3, 1965 p 1–144
(JPRS-31625; TT-65-32120) CFSTI: $5.00

Articles on electronic instruments, electrical measuring instruments and devices, instruments and devices for automation and remote control, computer instruments and devices, gyroscopic and navigational instruments, thermal instruments, and general problems of instrument design are presented. For individual titles see N65-31651–N65-31674. E.H.

N65-31655 Joint Publications Research Service, Washington, D. C.
CALCULATION OF THE OPTIMAL PARAMETERS OF A MAGNETOELECTRIC TORQUE CONVERTER
T. S. Astashevskaya *In its* Izv. VUZov: Instr. Building, Vol. VIII, No. 3, 1965 p 39–50 ref (See N65-31650 20-14) CFSTI: $5.00

The design of a magnetoelectric torque converter with a multipole magnet is considered. Relations of the structural parameters for which the torque converter provides maximum torque at the output are presented. Author

N65-31660 Joint Publications Research Service, Washington, D. C.
DETERMINATION OF THE REGION OF APPLICATION OF THE CONSTANT SPEED REGULATOR
I. Kh. Tsukerman and I. S. Rozen *In its* Izv. VUZov: Instr. Building, Vol. VIII, No. 3, 1965 p 79–85 ref (See N65-31650 20-14) CFSTI: $5.00

A determination is made of the region of application of the constant speed regulator for processes of first order with pure lag and the criteria of the quality of the converging transient processes are presented. Author

N65-31666 Joint Publications Research Service, Washington, D. C.
ON THE EFFECT OF BASE ROTATION ON GYRO DRIFT IN INTERNAL SPACE
V. A. Pavlov *In its* Izv. VUZov: Instr. Building, Vol. VIII, No. 3, 1965 p 119–120 refs (See N65-31650 20-14) CFSTI: $5.00

The possibility is shown of drift in inertial space of an ideal gyro in a gimbal support due to the rotation of the instrument base. Author

N65-31667 Joint Publications Research Service, Washington, D. C.
FLOATED GYROCOMPASS WITH RIGID TORSION SUSPENSION
M. A. Sergeyev *In its* Izv. VUZov: Instr. Building, Vol. VIII, No. 3, 1965 p 121–129 ref (See N65-31650 20-14) CFSTI: $5.00

This paper studies in the first-order approximation the motion of the sensitive element of a floated gyro with rigid torsion suspension and presents the equation for the period of free undamped azimuthal oscillations. Author

N65-31668 Joint Publications Research Service, Washington, D. C.
SEMIGRAPHICAL METHOD OF ACCOUNTING FOR THE EFFECT OF BEARING DRY FRICTION FORCES ON GYROSCOPE OPERATION
M. N. Katkhanov and V. P. Demidenko *In its* Izv. VUZov: Instr. Building, Vol. VIII, No. 3, 1965 p 130–135 refs (See N65-31650 20-14) CFSTI: $5.00

This paper considers a semigraphical method suggested by the authors for the determination of the effect of the dry friction forces in the bearings of a gyro instrument support as a function of the conditions. A specific example is used to illustrate the principle of the construction and use of the nomogram intended for the determination of the effectiveness factor of the action of the corresponding friction moment. Author

N65-31669 Joint Publications Research Service, Washington, D. C.
SETUP FOR DETERMINING THERMAL CONDUCTIVITY
O. B. Tsvetkov *In its* Izv. VUZov: Instr. Building, Vol. VIII, No. 3, 1965 p 136–139 refs (See N65-31650 20-14) CFSTI: $5.00

Equipment is described for the study of thermal conductivity of liquids and gases at various temperatures and pressures up to 150 bar. Experimental data are presented on the thermal conductivity of Freon-12, Freon-13 and Freon-142 in the liquid phase. Author

N65-31674 Joint Publications Research Service, Washington, D. C.
MECHANISMS FOR RECTIFYING INSTRUMENT NONLINEARITIES
L. N. Reshetov *In its* Izv. VUZov: Instr. Building, Vol. VIII, No. 3, 1965 p 173–180 (See N65-31650 20-14) CFSTI: $5.00

Measuring elements often have displacements which are not proportional to the measured quantity. In order to obtain a uniform scale it is necessary to use a linkage. This paper presents the design of a four-bar linkage for this purpose with three values of the transmission ratio. Author

N65-31733# Bettis Atomic Power Lab., West Mifflin, Pa.
REMOTELY OPERABLE DIMENSIONING EQUIPMENT ACCURATE TO ±0.002 IN.
J. D. Eichenberg, F. J. Lennon, and K. L. Rupp Jun. 1964 17 p Presented at the 12th Conf. on Hot Labs. and Equipment, San Francisco, 30 Nov.–3 Dec. 1964
(Contract AT(11-1)-GEN-14)
(WAPD-T-1688)

Instruments have been designed and constructed at the Bettis Atomic Power Laboratory (Bettis) to remotely measure the dimensions of irradiated samples with an accuracy of plus or minus 0.002 in. The zero to three inch range instrument utilizes a Bausch and Lomb optical micrometer coupled with a BAPL designed movable bottom anvil and positioning table. The three to thirty inch range instrument, designated as an Ultramicrometer, was designed and constructed by Bettis. The design objectives have been achieved and both instruments have been in service in the high level cells at Bettis for over one year. Author

N65-31753# Wyoming Univ., Laramie.
THERMOCOUPLE CALIBRATION IN A SUBSONIC AIR FLOW
Harry L. Matthew (M.S. Thesis) May 1965 92 p refs
(AD-617305)

This investigation has resulted in the construction of a testing device for the calibration of a variety of test thermocouple probes. From the testing of fourteen types of probes a determination has been made of the most satisfactory design for thermocouples that are to be used for recording temperature in a subsonic air flow. Author

N65-31806# Sandia Corp., Livermore, Calif.
CARRIER-ERASE RECORDING SYSTEM DEVELOPMENT REPORT
J. F. Barham Mar. 1965 46 p
(Contract AT(29-1)-789)
(SCL-DR-64-131)

This report qualitatively explains the theory of carrier-erase recording. This includes prerecording the tape, the erasure phenomena as viewed from a magnetic transfer characteristic (B-H curve), the demodulation process and the difference between CE and true amplitude-modulated waveforms, and some discussion of noise factors. A typical data acquisition system, recorder and package hardware, with the playback and display system is described to illustrate some of the realizable results. Author

N65-31817# Oak Ridge National Lab., Tenn.
INSTRUMENTATION AND CONTROLS DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING SEPTEMBER 1, 1964
C. J. Borkowski and C. S. Harrill Aug. 1965 172 p refs
(Contract W-7405-ENG-26)
(ORNL-3782) CFSTI: $5.00

New developments in research instrumentation and controls are presented and include nanosecond circuitry and techniques, pulse counting and analysis, electrometers and accessories, miscellaneous electronics developments, instrumentation for automatic control of research equipment, instrumentation for biomedical research, detectors of ionizing particles and radiation, radiation monitors and components, data collection and analysis, process instrumentation and controls systems engineering, process instrumentation development, reactor instrumentation and controls analysis and development, instrumentation for reactor operation, and support for the high voltage accelerator program. R.N.A.

N65-31841# Ling-Temco-Vought, Inc., Dallas, Tex.
INVESTIGATION AND DEVELOPMENT OF TECHNIQUES TO EXTEND THE UTILITY OF PACK PROCESSES AND COMPOSITIONS FOR COATING MOLYBDENUM AND COLUMBIUM ALLOYS Second Quarterly Progress Report, 1 Sep.–1 Dec. 1964
W. L. Aves, Gordon Bourland, and Glenn M. Ecord [1964] 66 p
(Contract AF 33(615)-1678)
(Rept.-2-53052/4R-2147A; AD-463563)

Progress is reported on the program to extend the use and versatility of the pack cementation process. The deposition characteristics of various halides were evaluated with seven different coating elements on TZM molybdenum and B-66 niobium alloys. The program was concluded with the deposition of vanadium powder. Also, the effectiveness of depositing single-cycle oxidation resistant coatings by the slip-pack, slip-chamber, and segregated halide methods was evaluated in terms of the conventional pack process. Oxidation resistant coatings were deposited on all three alloys, TZM molybdenum, B-66 niobium, and D-43 niobium by each technique. The most oxidation resistant coatings were deposited by means of the segregated halide technique for the niobium alloys. The slip-chamber method was the most versatile of the three procedures. E.E.B.

N65-31849# Symetrics Engineering Corp. of Florida, Satellite Beach.
BROADBAND SPURIOUS-RADIATION DETECTOR SYMMETRICS ENGINEERING MODEL 302A Final Test Report
21 Jan. 1965 70 p
(Contract AF 08(606)-6531)
(AD-463464)

A new state-of-the-art broadband spurious radiation detector is described. System block diagrams and descriptions of components, packaging and shielding, and performance data are included. The design concept and development history of the detector are discussed. Acceptance test procedures are outlined and test results are tabulated. The detector met most of the specification requirements. Recommendations for some improvements are given. R.N.A.

N65-31858# Joint Publications Research Service, Washington, D. C.
THE "KRISTALL" LIGHT RANGE FINDER
G. A. Feldman and F. V. Shirov 26 Aug. 1965 11 p refs Transl. into ENGLISH from Geodez. i Kartograf. (Moscow), no. 6, Jun. 1965 p 9–14
(JPRS-31736; TT-65-3231) CFSTI: $1.00

A visual light range finder, the Kristall, is described in detail. The Kristall uses a superposed optical system which serves as both transmitter and receiver of light, and a single Kerr condenser which acts as a modulator and demodulator of light flow. The separation of the transmitted and received light takes place in a prism bipolarizer located in the optical system. The entire installation weighs about 40 kg. Field trials by four observers were carried out on standard lines from 100 to 1952 meters in length. The results indicate very small experimental error, and substantiate the advisability of using built-in optical systems in visual light range finders. J.M.D.

N65-31867# School of Aerospace Medicine, Brooks AFB, Tex.
THE PERSONALIZED TELEMETRY MEDICAL MONITORING AND PERFORMANCE DATA-GATHERING SYSTEM FOR THE 1962 SAM-MATS FATIGUE STUDY, 9 JUNE 1960–JANUARY 1962
David G. Simons, Wesley Prather, and Franklin K. Coombs Apr. 1965 34 p refs
(SAM-TR-65-17; AD-467733)

This report describes the instrumentation used for gathering and recording data for the 1962 USAF SAM-MATS, Fatigue Study at Dover AFB, Del. Six biomedical measures and six performance measures were recorded continuously while 4 pilots accomplished an aircraft simulator "flight" of 24 hours each. The biomedical monitoring instrumentation included EEG, ECG, respiration, skin temperature, BSR, and GSR. A 6-channel personalized biomedical radio telemetry system was used to transmit these measures. Continuously recorded performance measures included three pilot-control functions and three aircraft instrument readings. The circuitry and functions of the personalized telemetry system are detailed, including technics developed to resolve all major problems encountered. Most of the recorded data were suitable for visual pattern analysis. Author

N65-31886# Fairchild Camera and Instrument Corp., Syosset, N. Y. Systems Management and Engineering Dept.
DESIGN AND DEVELOPMENT OF A DISTANCE MEASURING DEVICE Monthly Progress Report, 1–30 Apr. 1965
Eugene Brown [1965] 22 p
(Contract DA-28-017-AMC-975(A))
(MPR-1; AD-618534)

A block diagram of a revised Distance Measuring Device (DMD) for weapons was developed and is shown. Innovations include centralized and improved power supply regulation with integrated circuits, and the incorporation of the filtering system into the regulator package. Requirement calculations of distance measuring fuzes for weapons with ranges up to five kilometers were initiated with a trajectory analysis, and with DMD computation evaluations for several angles of inclination. Results of computations for −40°, −60°, and −80° angles of inclination, and a velocity of 100 feet per second at the 18000-foot point are shown graphically. A similar plot for a vacuum trajectory is also presented. It was decided that further investigations of attitude corrections should be approached by integrated digital computations. G.G.

N65-31888# General Motors Corp., Santa Barbara, Calif. GM Defense Research Labs.

FABRY-PEROT RESONATORS AT 5 Gc AND 35 Gc FOR WAKE IONIZATION MEASUREMENTS IN A FREE-FLIGHT BALLISTICS RANGE

R. A. Hayami, D. H. Auston, K. J. Kelley, and J. R. Faulkner May 1965 57 p refs

(Contracts DA-01-021-AMC-11359(Z); AF 04(694)-582; ARPA Order 347; Proj. Defender)

(TR65-19B; BSD-TR-65-300; AD-466366)

Substantial progress has been made in the development of operational Fabry-Perot resonator systems for ionization measurements in the wakes of hypersonic projectiles fired in a ballistics range. This report describes in detail a "Mark I" version of a Fabry-Perot resonator system which has been installed on a range. Considerable emphasis, however, is placed on the general considerations of the parameters which affect the interpretation of the plasma-electromagnetic wave interaction and hence the resonator system design. Author

N65-31929# Battelle Memorial Inst., Columbus, Ohio. Transducer Information Center.

COMPILATION OF TRANSDUCER RESEARCH, DEVELOPMENT AND TESTING CONTRACTS

15 Apr. 1965 22 p

(Contract AF 33(615)-1819)

This addendum to a previous contract compilation lists 47 current and recently completed contracts and projects. The compilation was prepared to provide users and manufacturers of transducers and those managing or planning transducer research programs with a comprehensive source of information about other organizations and individuals engaged in similar activities. E.E.B.

N65-31951*# Rocketdyne, Canoga Park, Calif.

FEASIBILITY STUDY OF RADIATION PYROMETER FOR NUCLEAR ROCKET APPLICATION Final Report

J. Perow, B. E. Harper, and P. A. Kinzie 31 Oct. 1964 168 p refs

(Contract NAS3-5213)

(NASA-CR-54306; R-5947) CFSTI: HC $5.00/MF $1.00 CSCL 18D (Declassified)

An analytical study was conducted to determine the feasibility of developing a radiation pyrometer to be used as a control instrument for measuring the temperature of a nuclear rocket core material. The system recommended for further experimental study is a device employing a direct viewing system and a dual foil thermocouple as a sensing element. Irradiation of selected pyrometer components is also recommended as a parallel effort to provide radiation data relative to the problem areas. Author

N65-31953# Library of Congress, Washington, D. C. Aerospace Technology Div.

A HIGH-SPEED TRANSISTORIZED MAGNETOMETER Translations of Soviet Scientific and Technical Literature

V. S. Voronin and V. N. Kanunnikov 18 Aug. 1965 11 p refs Transl. into ENGLISH from Pribory i Tekhn. Eksperim. (USSR), no. 2, 1965 p 160–163

(ATD-T-65-63)

A magnetometer is described which permits continuous measurement of constant magnetic fields in the range of 0–80 gauss, with an accuracy of ±0.05%–±0.01 gauss. The instrument's reaction time is 10^{-3} sec.; its output is direct current (0–220 mamp) proportional to the field intensity. The magnetometer is used for magnetic measurements on the circular electron phasotron at the Physics Institute of the Academy of Sciences, and also in the stabilization system of the initial field of this accelerator. Author

N65-32008# California Univ., Berkeley. Lawrence Radiation Lab.

DESIGN, CONSTRUCTION, AND OPERATION OF A DIFFERENTIAL MICROMANOMETER. PART II: THEORY AND OPERATIONAL CHARACTERISTICS

Peter R. Rony 8 Apr. 1965 118 p refs

(Contract W-7405-ENG-48)

(UCRL-11218, Pt. II)

A differential micromanometer capable of measuring 100 microtorr to an accurracy of ±2% was designed, constructed, and tested. The micromanometer is being used as Wrede–Harteck gauge, a device that converts an atom concentration into a pressure differential in a low pressure gaseous system. The pressure difference is sensed by a membrane manometer constructed as a differential capacitor that forms two legs of a resonant bridge network excited by a radio frequency source. The bridge output is amplified and fed to a phase sensitive detector that determines the direction of unbalance and develops a dc voltage that can be used in a feedback loop system to restore the diaphragm to its null position, or in an open loop system and recorded directly. The design and construction of the electronics unit, consisting of the power supply, amplifier, oscillator, phase detector, and recorder output are described. In addition, the theory of the differential micromanometer; the design and construction of the transducer, bridge, and calibration circuit; the operation of the electronics; and the calibration of the transducer are described. The characteristics of comparative systems are discussed. R.N.A.

N65-32104# California Univ., Berkeley. Lawrence Radiation Lab.

LITHIUM-DRIFTED SILICON RADIATION DETECTOR PRODUCTION PROCESS

Robert P. Lothrop and Harry E. Smith 11 Jun. 1965 11 p ref

(Contract W-7405-ENG-48)

(UCRL-16190) CFSTI: $1.00

A process for the fabrication of lithium-drifted silicon radiation detectors with thin entrance windows is described. High-resistance p-type silicon is diffused, drifted, and processed to form devices useful in a wide range of charged-particle and low-energy gamma experiments. Author

N65-32127# Union Carbide Nuclear Co., Oak Ridge, Tenn. Oak Ridge Gaseous Diffusion Plant.

AN IMPROVED FAST NEUTRON MONITOR

G. B. Seaborn 27 Aug. 1965 33 p refs

(Contract W-7405-ENG-26)

(K-1642) CFSTI: $2.00

An improved fast neutron monitor has been developed, superseding the instrument presently in use for estimating the weights of solid uranium-fluorine deposits in plant process equipment. The new unit is superior in possessing a two-thirds greater sensitivity with one-half the weight of the original device. It also contains a ratemeter, a built-in battery charger, and several other improvements. These features, together with a description of the electronic circuits employed, are described in detail. Author

N65-32145# Weapons Research Establishment (Australia).
THE EFFECT OF IMAGE WIDTH AND BACKGROUND DENSITY ON THE LIMINAL CONTRAST OF PHOTOGRAPHIC IMAGES
D. J. Gambling Jul. 1965 16 p refs
(WRE-TN-ISD-61)

The contract at which a 3:1 rectangular image can be detected on Plus-X panchromatic film has been determined as a function of image width and background density. It is shown that the numerical value of this liminal contrast for a silhouetted image is less than that for a highlighted one of the same size, and that for a given image width, the liminal contrast decreases as the background density is reduced. Author

N65-32196*# Raymond Engineering Lab., Inc., Middletown, Conn.
TAPE REPRODUCER MODEL 1738: OPERATIONAL MANUAL
21 Aug. 1963 39 p Prepared for JPL
(Contracts NAS7-100; JPL-950105)
(NASA-CR-64450; REL-WO-801) CFSTI: HC $2.00/MF $0.50 CSCL 14C

Described are input and output signals and waveshapes of testpoints which facilitate the operational setup of the 1738 video recorder. The model 1738 recorder accepts serial bit RZ binary data at a fixed input rate of 10700 bits per second and can store a minimum of 5×10^6 bits. Also, it reproduces jitter free, synchronous, serial NRZ binary data at a fixed output rate of 8.33 bits per second. Presented are data on: system operation, data automation system interface wave forms, operational support equipment system wave forms, data encoder wave forms, umbilical interface wave forms, test point wave forms, and power requirements. Included are harness drawings which describe the interconnection of the transport and the electronic modules, and a test plan. S.C.W.

N65-32212# National Bureau of Standards, Boulder, Colo.
PERFORMANCE MEASUREMENTS ON THE NM-52A FIELD INTENSITY METER First Technical Report, Jan.–Jun. 1964
Archie H. Dove Griffiss AFB, N. Y., RADC, Jun. 1965 47 p refs
(Contract AF 30(602)-2936)
(RADC-TR-65-29; AD-619040)

Performance measurements of the meter were conducted to determine the accuracy of the instrument and its ability to furnish factual data radio frequency fields. These measurements are to be used for reference and evaluation and to correlate with other instruments performing the same type of tests in the same environment. An effort has been made to describe tests which affect field-strength measurements and to supplement the conclusions of this report with calibration charts and curves. Author

N65-32213# Oslo Univ., Blinder (Norway). Norwegian Inst. of Cosmic Physics.
A SWEEP-FREQUENCY SPECTRUM-ANALYZER FOR RECORDING IN THE RANGE 1 TO 45 CPS ON A PAPER CHART RECORDER Scientific Report No. 2
Alv Egeland and Sven Olsen (Kiruna Geophys. Obs., Sweden) 5 May 1965 24 p refs Prepared jointly with Kiruna Geophys. Obs., Sweden
(Contract AF 61(052)-811)
(AFCRL-65-513; AD-619037)

The spectrum of natural electromagnetic phenomena between 6 cps and 40 cps is dominated by the earth-ionosphere cavity resonance mode, while below 6 cps different types of micropulsations are most pronounced. A number of different equipment and measuring techniques have been used for recording of the low ELF (Schumann) band and micropulsations (cf. e.g. Lokken, 1964, Galejs, 1964). A new instrument for recordings of the natural electromagnetic phenomena in the frequency range 1 to 45 cps has been constructed. This equipment is a swept frequency spectrum analyzer whose output is recorded on a paper chart recorder. This analyzer will be described later in great detail, and a few examples of recordings obtained with this instrument will be shown. Author

N65-32222# Lenkurt Electric Co., Inc., San Carlos, Calif.
INTERCONNECTING GROUPS OA-7021(XW-1)/FCC-17, OA-7151(XW-1)/FCC-17 AND OA-7152(XW-1)/FCC-17 (SUPERGROUP INTERCONNECT PANELS), PHASE B
Thomas F. Curry and T. R. Holmes Griffiss AFB, N. Y., RADC, 1 Jul. 1965 54 p refs
(Contract AF 30(635)-11188)
(RADC-TDR-64-470, Vol. III; AD-618424)

A summary of the quality assurance test data for the completed supergroup interconnect panel is presented. The panel was developed to interconnect a 60-channel supergroup between two multiplexer sets, or between a multiplexer set and a commercial multiplex system at the same terminal location. Tests with two supergroup interconnecting panels established their compliance with design requirements as set forth in the equipment specifications, and their high reliability. G.G.

N65-32226# Library of Congress, Washington, D. C. Aerospace Technology Div.
METHODS OF HIGH-TEMPERATURE MEASUREMENT OF GASES Surveys of Soviet-Bloc Scientific and Technical Literature, Report No. 3
22 Jul. 1965 17 p refs Compilation of Abstracts
(ATD-P-65-53; AD-618532)

Presented is an annotated bibliography on methods used in the high temperature measurement of gases which appeared in Soviet-bloc open literature between 1958 and 1965, and a list of articles available in full translation. S.C.W.

N65-32282# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CALIBRATION RACK
V. I. Zimenkov 14 Jul. 1965 6 p Transl. into ENGLISH from Russian Patent no. 152115 (Appl. no. 764417/26-10, 10 Feb. 1962) 2 p
(FTD-TT-65-232/1+2+4; AD-618646)

A calibration rack with improved precision in measurement of forces is proposed. The principle of the proposed calibrator, which can be used as a wind tunnel balance, consists of tightening filaments individually for the different loads. S.C.W.

N65-32293# Bendix Corp., Baltimore, Md. Friez Instrument Div.
FURTHER DEVELOPMENT OF THE AN/DMQ-9 ROCKETSONDE Final Report, Aug. 1964–Apr. 1965
Kenneth W. Kidd Jun. 1965 33 p refs
(Contract AF 19(628)-4045)
(EIR-630; AFCRL-65-458; AD-618292)

The AN/DMQ-9 rocketsonde is an expendable meteorological instrument package designed for use with the Arcas rocket vehicle to obtain vertical profiles of temperature and winds in the upper atmosphere between 80,000 feet and 200,000 feet. The instrument is of the transponder type and is compatible with the AN/GMD-2 Rawin Set ground equipment. The purpose of this effort was to up-grade the existing design to provide for improved flight performance and ease of handling in the field. Flight tests conducted at the Air Force Eastern Test Range, Cape Kennedy, Florida indicate that the resulting instrument package is suitable for field use when the Rawin Set is supplemented with a parametric amplifier. Author

N65-32332# Bettis Atomic Power Lab., Pittsburgh, Pa.
SMALL DISPLACEMENT, SELF-BALANCING DIFFERENTIAL MANOMETER
W. H. Bell Jun. 1964 6 p Presented at the Joint Automatic Control Conf., Rensselaer Polytechnic Inst., Troy, N. Y., 22–25 Jun. 1965
(Contract AT(11-1)-GEN-14)
(WAPD-T-1708; CONF-674-1)

A self-balancing liquid servomanometer has been designed and successfully used to measure pressure drops of 0.02 in. to 100 in. of virtually any manometer fluid at static pressures up to 2,500 psi. This manometer is capable of following more rapid changes in pressure drop than can be followed by conventional servo liquid manometers because of a design feature which minimizes the quantity of the fluid that must be drawn from the process while the instrument is assuming a new balance point. Tests conducted with carbon tetrachloride and water as the manometer and system fluids respectively showed that the manometer could balance within one minute after a step change in pressure drop has occurred even when the lead lines contained 50 feet of 0.040 in. I.D. tubing. This compares to a balancing time of many hours for a conventional U-tube manometer filled with CCl_4. Author

N65-32337# Joint Publications Research Service, Washington, D. C.
AN ELECTROMETRIC DEVICE FOR MEASURING THE INTEGRAL ABSORBED ENERGY OF ROENTGEN AND GAMMA RADIATION
N. G. Yushchenko 8 Sep. 1965 7 p Transl. into ENGLISH from Med. Radiol. (Moscow), v. 10, no. 6, Jun. 1965 p 83–85
(JPRS-31902; TT-65-32396) CFSTI: $1.00

The determination of radiant loads by means of an electrometric device that automatically considers absorbed radiant energy in the human body during irradiation is discussed. The device consists of three horizontal ionization chambers and an electronic system which records differences in ion currents passing through the chambers during irradiation. The ionization chambers are situated in a plane perpendicular to the direction of the central ray of roentgen or gamma radiation. The circuitry for the device is shown and its operation is explained in detail. E.E.B.

N65-32338# Bettis Atomic Power Lab., Pittsburgh, Pa.
AN APPARATUS FOR THE MEASUREMENT OF THE THERMAL CONDUCTIVITY OF IRRADIATED SOLIDS IN THE RANGE 100–200° C
D. Jaffe Jun. 1964 23 p refs Presented at the Thermal Conductivity Conf., San Francisco, Oct. 1964
(Contract AT(11-1)-GEN-14)
(WAPD-T-1742; CONF-764-3)

A comparative type apparatus was developed for measuring the thermal conductivity of thin (0.50 to 0.150 in.) specimens of solid materials having relatively high thermal conductivites, both prior to and after irradiation. The principle of measurement of the apparatus involves relating the time to boil a given volume of a liquid to the thermal resistance of the specimen, where thermal resistance equals the thickness/area × thermal conductivity. The apparatus has been calibrated for use with one-half-inch square specimens having thermal resistance values in the range of approximately 1 to 10 sec-° C/cal. In this range of thermal resistance values, the precision of the apparatus was found to be ±0.05 to 0.1 sec-° C/cal. To date, all measurements have been carried out at an average specimen temperature of 120° C, but this range can be extended to 100–200° C without major modifications to the apparatus. Also, it is felt that the apparatus can readily be calibrated and used for measurements of specimens with thermal resistance values well above 10 sec-° C/cal. Complete procedures for the remote in-cell measurement of the thermal conductivity of irradiated specimens have been developed and are described in detail. Author

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N65-31306# California Univ., Berkeley. Lawrence Radiation Lab.
THE KINETICS AND MECHANISM OF FINAL STAGE DENSIFICATION IN THE VACUUM HOT-PRESSING OF FINE-GRAINED ALUMINUM OXIDE
Ronald C. Rossi (Ph.D. Thesis) 20 Jul. 1964 22 p refs
(Contract W-7405-ENG-48)
(UCRL-11564)

The kinetics of the final stage densification of fine-grained aluminum oxide has been studied by vacuum hot-pressing between 1150° and 1350° C and from 2000 to 6000 psi. The kinetics is consistent with the Nabarro–Herring creep model. The activation energy for the final stage densification is 115 kcal/mole which agrees with the activation energy for diffusion of aluminum ions. The experimentally determined activation energy for grain growth is 36 kcal/mole which agrees with the extrinsic activation energy for oxygen diffusion. The densification process takes place by two mechanisms: particle rearrangement and diffusional creep. The extent of densification that takes place in the initial stage depends upon the amount of sliding, fragmentation, and plastic flow that occurs. The final stage of densification takes place by diffusional creep and is controlled by aluminum ion diffusion in the case of aluminum oxide. Author

N65-31524# Joint Publications Research Service, Washington, D. C.
DISCUSSION OF EFFICIENCY OF TECHNICAL DEVICES
A. A. Kharkevich 18 Aug. 1965 11 p Transl. into ENGLISH from Vestnik Akad. Nauk SSSR (Moscow), no. 6, 1965 p 27–33
(JPRS-31597; TT-65-32092) CFSTI: $1.00

The problem of quantitatively characterizing the useful action of technical devices is discussed. It is argued that the classifical definition of machine efficiency as the ratio of output to input power is an inadequate characterization for both energy converting devices and for nonconverters. The definition is regarded as unsatisfactory in the context of modern devices such as X-ray machines, computers, and accelerators. Other criteria are discussed in which the denominator of the ratio reflects wasted effort involved in the operation of the device; with respect to information systems, for example, the quantity of transmitted information divided by the loss in transmission of energy is discussed as a standard for evaluation of efficiency. J.M.D.

N65-31546# Hanford Atomic Products Operation, Richland, Wash.
PREPARATION FOR STUDIES OF THE HARDENING EFFECT OF ELECTROHYDRAULIC SHOCK WAVES TO PLUTONIUM
John H. Rector 5 Oct. 1964 8 p refs
(Contract AT(45-1)-1350)
(HW-SA-3738)

Aluminum discs of 1/16" thickness were exposed to electrohydraulic shockwaves and the resulting hardening effect was observed. Sufficient evidence was found to substantiate a hardening effect without gross deformation of more than two percent. A better method for holding the blank in intimate contact with the platten will eliminate some deformation. A firing chamber complete with leads and connector was designed and built to be used for electrohydraulic testing with plutonium materials. G.G.

N65-31572*# Tennessee Univ., Knoxville.
ANALYSIS OF THE VISCO SEAL. PART I: THE CONCENTRIC LAMINAR CASE
William K. Stair Washington, NASA, Aug. 1965 33 p refs
(Grant NsG-587)
(NASA-CR-285) CFSTI: HC $2.00/MF $0.50 CSCL 13K

This report presents a theoretical analysis of the visco-type shaft seal when operating concentrically in laminar flow. The analysis, which is patterned after the work of Boon and Tal, shows the development of the sealing coefficient and dissipation function. These two parameters have been computed for the range of seal geometries most likely to be encountered in practice and are presented in tabular form. Author

N65-31585# Vickers, Inc., Troy, Mich. Aerospace Div.
INVESTIGATION OF A HIGH SPEED DIRECTLY DRIVEN ENGINE HYDRAULIC PUMP Quarterly Progress Report, Apr.–Jun. 1965
R. W. Holmes and R. P. Lambeck 6 Jul. 1965 12 p
(Contract AF 33(615)-1603)
(QPR-4; AD-466034)

Progress is reported on the development of an 18000 rpm hydraulic pump capable of extended life on a jet engine application. The unit was performance tested with overall efficiency less than the specification goals. The volumetric portion was found to be 99%. The results of this testing are given. Approximately 30 hours of testing at 18000 rpm was accumulated when the calibration run at 19800 rpm was performed. At that time the first hardware failure occurred. One set of pistons seized and the piston drive pin fractured. Subsequent examination showed other piston drive pins and bearings were cracked but this was attributed to the initial failure. E.E.B.

N65-31609# Battelle Memorial Inst., Columbus, Ohio.
SURVEY OF ALTERNATING-CURRENT POWER SUPPLIES FOR WELDING
H. E. Pattee Huntsville, Ala., Army Missile Command, Nov. 1964 34 p refs
(Contract DA-01-021-AMC-203(Z))
(RSIC-329; AD-465284)

This report presents the results of a survey made to determine the availability of an unusual alternating-current power supply for welding. Studies which are currently under way require a power unit with variable frequency ouput conditions and an open-circuit voltage which is double the usual amount. Equipment meeting all of the requirements is not available commercially; however, power units of the type desired are in the design stages and some prototype construction has been undertaken. Then design of a variable-frequency power supply with the specified output-voltage characteristics appears to be technically feasible. A number of prototype power supplies with output characteristics which can be controlled or programmed to suit the welding application have been constructed. Considerable research has been conducted with such equipment to study the arc characteristics and to relate weld properties to the shape of the output-current waveform. The results of such investigations are reported also. Author

N65-31617# Battelle Memorial Inst., Columbus, Ohio.
CRYOGENIC FORMING OF TYPE 301 STAINLESS STEEL
A. G. Imgram Huntsville, Ala., Army Missile Command, 21 Apr. 1965 43 p refs
(Contract DA-01-021-AMC-11706(Z))
(RSIC-408; AD-467050)

Deformation at subzero temperatures significantly increases the strength of 300 series, stainless-steel alloys; Type 301 stainless steel exhibits the greatest response of any commercial alloy. High strength, cryogenically-formed, stainless-steel sheet can be produced, but welding reduces its strength. A process has been developed by which a welded preform is expanded at cryogenic temperatures to final size by internal pressurization. This technique has been used to produce pressure vessels of prototype and actual rocket motor case configurations. Author

N65-31637# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
POLYORGANOSILOXANES—LIQUID BASE OF HIGH TEMPERATURE CONSISTENT OILS
Ye. M. Oparina, G. S. Tubyanskaya, and R. I. Kobzova 30 Jun. 1965 15 p refs Transl. into ENGLISH from Khim. i Tekhnol. Topliv i Masel (Moscow), no. 1, 1964 p 32–38
(FTD-TT-65-322/1+2+4; AD-617947)

Comparison is made of various polyorganosiloxane liquids for use as bases in high temperature consistent oils. Temperatures at freezing and boiling points, viscosity at various temperatures, and molecular weights are given; molecular weights having been determined cryoscopically with a specially developed thermistor. Evaporability of the liquids in a 0.1 mm layer at temperatures between 200° and 350° C and the thermo-oxidation stability of the liquids are given. Polymethylsiloxane liquids, intended for operation at 200° C, have better physico-chemical properties, thermo-oxidation stability, and anti-wear properties than the polyethylsiloxane liquids. With regard to viscosity-temperature and anti-wear properties, the polymethylsiloxanes are better than the polymethylphenylsiloxane liquids. For use as liquid bases at temperatures above 200° C, the polymethylphenylsiloxanes and polymethylchlorophenylsiloxanes are recommended. M.W.R.

N65-31672 Joint Publications Research Service, Washington, D. C.

ON THE PRESSURE ANGLE OF A FUNCTIONAL CAM MECHANISM

K. G. Krol' *In its* Izv. VUZov: Instr. Building, Vol. VIII, No. 3, 1965 p 157–167 (See N65-31650 20-14) CFSTI: $5.00

The paper is devoted to obtaining the design equations for the pressure angle of a functional cam mechanism with one or two degrees of freedom (conoid mechanism). The determination of the pressure angle in terms of the angle of rise in longitudinal and lateral sections is also considered. Author

N65-31673 Joint Publications Research Service, Washington, D. C.

A GRAPHICAL METHOD OF DETERMINING VELOCITY AND ACCELERATION OF A CONDUCTOR WHEN WINDING

N. M. Tsvetkov *In its* Izv. VUZov: Instr. Building, Vol. VIII, No. 3, 1965 p 168–172 (See N65-31650 20-14) CFSTI: $5.00

This paper considers a graphical method of determining the instantaneous values of the velocity and acceleration of a conductor during winding which permits (figs 2 and 3) finding these quantities for all cases of winding on rectangular frames. Author

N65-31709# Air Force Dept., Washington, D. C.

PROFILE MILLING REQUIREMENTS FOR THE HARD METALS, 1965–1970

May 1965 42 p Report of the Ad Hoc Machine Tool Advisory Comm.

(AD-617760)

It is recommended that the Department of Defense and prime contractors and subcontractors in the aerospace industry begin a program to buy 551 numerically-controlled profile milling machines for use on hard metals. Approximately 600 existing machines are available throughout the United States at the present time when 35% of the metals used in aerospace vehicles are hard metals; and this represents a shortage of 299 machines. This shortage is expected to reach 551 machines by 1969; ten years from today, when it is estimated that hard metals will approach 70% usage, the shortage will be even greater if adequate long-range plans are not undertaken. Incentives should be provided to encourage the investment of private capital in such equipment. M.W.R.

N65-31718# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DETERMINING WEAR RESISTANCE OF FRICTION COUPLINGS BY THE METHOD OF CONSUMING WORKING MEDIUM THROUGH THE SLOTS BETWEEN THE FRICTION SURFACES

F. Ya. Zagavura 18 May 1965 10 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Ukr. RSR (Kiev), no. 5, 1964 p 603–606

(FTD-TT-65-69/1+2; AD-617322)

A method is presented for the determination of wear resistance of friction couplings by the measurement of the consumption of the working medium through the gaps between the friction surfaces. The working medium can be gas or liquid. The change in mass per unit time or per unit volume of the working medium or the change in working pressure per unit time allows the automatic measurement and recording of data on the wear resistance of the friction couplings during testing. The method has high sensitivity and does not require costly equipment. E.E.B.

N65-31731# SKF Industries, Inc., King of Prussia, Pa. Research Lab.

A BASIC STUDY OF THE SLIDING CONTACTS IN ROLLING BEARINGS Project No. 1 Summary Report, 16 Apr. 1964–16 Apr. 1965

C. J. Belsky, J. I. Mc Cool, J. T. Walker, J. A. Kamenshine, K. Tataiah et al [1965] 125 p refs

(Contract NOw-64-0428-c)

(AL65L045; AD-617735)

Tests on ball bearings indicate that smearing in a sliding contact between two balls produced under controlled conditions is reproducible. The limiting load of smearing varies only within ±15% under given conditions of speed, lubrication, heat transfer, and surface characteristics. The smearing load decreases with increasing test speed under the pure sliding and heat removal conditions used. Within the range of lubricants examined, base stock viscosity was not found to affect smearing load; but TCP type additives appear to increase the limit load by a factor of two. Roller kinematic tests were also conducted to understand the smearing process, and test results are presented. The object of the study is to obtain criteria for the selection of material, design, and operating conditions that prevent smearing. L.S.

N65-31771# Sandia Corp., Albuquerque, N. Mex. Sandia Lab.

SOLDERING TO THIN FILM CIRCUITRY

E. L. Chavez Jan. 1964 9 p

(Contract AT(29-1)-789)

(SC-TM-363-63-14)

The soldering device and techniques used to solder component and interconnecting leads to thin-film circuitry are described. The device will successfully produce good solder joints of consistent mechanical strength and low electrical resistance if the solder temperature is maintained at determined levels. The device will prevent temperature rise at the soldering tip which will eliminate heat damage to the deposited thin-film circuitry and associated components. E.E.B.

N65-31795# Space Technology Labs., Inc., Redondo Beach, Calif.

SEVERITY OF NATURAL FLAWS AS FRACTURE ORIGINS First Quarterly Progress Report, Apr. 1–Jun. 30, 1965

P. N. Randall Jul. 1965 29 p refs

(Contract AF 33(615)-1611)

(STL-4439-6003-RU-000; AD-467622)

A program has been initiated to measure the severity of the following types of natural flaws: semi-elliptical surface cracks of various length-to-depth ratios, surface cracks of irregular shape, multiple cracks, and quick-opening cracks, which are not open cracks until highly stressed. In some cases analyses from fracture mechanics are available for interpretation of the test results; in other cases, severity will be measured in terms of equivalent sizes of semi-elliptical surface cracks of standard proportions (a/2c equals approximately 0.3). These results will permit more quantitative use of fracture mechanics in design against failure by brittle fracture. In the first quarter, the two materials—D-6AC steel and Ti-6Al-4V titanium alloy—have been obtained, and the heat treatment and machining of specimens has begun. Pull rods which permit adjustment of axiality are being machined, as well as an axiality indicator, which senses bending in the specimen. Design of a crack-opening displacement gage is also underway. Author

N65-31825# Worthington Corp., Harrison, N. J. Advance Products Div.

HIGH PRESSURE PUMP SEAL DEVELOPMENT Final Report

J. G. Williams and R. C. Hajner 1 Aug. 1964 154 p refs (Contract AT(30-1)-2682) (NYO-2682-1)

A high pressure mechanical shaft seal with limited leakage was developed for circulating pumps used in large water cooled and moderated nuclear power plants. A model seal operated successfully at film thicknesses ranging from 50 to 200 microinches, between sealing pressures of 1000 to 4000 psi, and shaft speeds from 900 to 3600 rpm. Overall hydraulic characteristics and performance of a large shaft seal were comparable to those of the model seal. However, large seal tests showed that existing manufacturing flatness tolerance stack-ups and sheer physical bulk of the seal components developed into factors of critical importance in terms of minimum permissible leakage rate. Simultaneous evaluation of two large seals mounted back to back on a common shaft introduced peculiar variables associated with the configuration of seals and bearings in the facility. These were not detected in the model seal test facility. Unstable seal operation at large film thicknesses, observed on both model and large seals, was characterized by large seal control pressure fluctuations and audible noise. These characteristics are suggestive of hydraulic phenomena associated with Reynolds number, hydraulic spring rate, or combinations of both. R.N.A.

N65-31838# General Electric Co., Cincinnati, Ohio.
SMALL GAS TURBINE ENGINE COMPRESSOR TECHNOLOGY Technical Progress Report, Feb. 11–Mar. 12, 1965
12 Mar. 1965 32 p
(Contract DA-44-177-AMC-180(T))
(TPR-10; AD-464658)

Research on high pressure ratio compressor technology for small gas turbine engines was conducted in the following areas: (1) inlet guide vane and rotor blade selection; (2) vaneless rotating diffuser research; (3) supersonic and subsonic stator selection; (4) scroll collector, diffuser, and elbow selection; (5) aerodynamic analysis; (6) mechanical analysis and bench tests; (7) test components design and fabrication; and (8) installation design. R.W.H.

N65-31866# Picatinny Arsenal, Dover, N. J. Feltman Research Labs.
DESIGN OF PRESSURE VESSELS FOR CONFINING EXPLOSIVES
A. Mackenzie, E. W. Dalrymple, and F. Schwartz Jul. 1965 23 p refs
(PA-TM-1643; AD-467730)

Factors which must be considered in designing pressure vessels to withstand, in a radiation environment, high, rapidly applied dynamic impulses (such as explosions) are defined and discussed. Of various metals tested for use in the walls of such vessels, several aluminum alloys were found most promising. Small amounts of explosive were initiated inside cylinders made of various metals (aluminum alloys, stainless steel, and lead), the cylinders being closed at the ends by being placed vertically on a steel plate and topped with a second steel plate held in place with a 500-pound lead weight. Cylinder length was varied from 18 to 24 inches, diameter from 3 to 12 inches, and wall thickness from 1/8 to 1 inch. As an explosive, spherical charges of C4 were used. The wall materials tested were 6061-T6, 2024-T4, 5086-H32, 5456-H323, and 7075-T6 aluminum alloys; 304 stainless steel; and lead. The report contains special sections on the design of end closures, shock attenuation, providing for electrical lead-throughs needed for instrumentation, and the use of a thin window in the vessel (needed for irradiation experiments). Author

N65-31884# Franklin Inst., Philadelphia, Pa. Franklin Inst. Research Labs.
PRELIMINARY STUDY OF THE ELASTIC ORIFICE AS A FLOW CONTROL DEVICE IN GAS-LUBRICATED BEARINGS Interim Report
P. Koch Jun. 1965 18 p
(Contract Nonr-2342(00))
(NASA-CR-64587; I-A2049-23; AD-618210)

The feasibility of using elastic orifices as flow control devices in externally pressurized, gas-lubricated bearings was studied. The configuration used in the study is shown. The configuration was chosen because it showed promise of fulfilling the main criterion for the success of the control device, substantial increase in throat area as the load pressure increased from zero load to a value approaching full bearing load. No attempt was made to design an orifice—only to determine whether it was possible to find values of the parameters such that the criterion was fulfilled for reasonable values of the supply pressure. The major effort was in the solution of the equations for the elastic deformation of the orifice. This was done through the development of a computer program based on a finite difference approximation to the equations of linear elasticity. It was concluded that it is possible to find values of the parameters such that the throat area of the nozzle changes substantially with the load on the bearing. E.E.B.

N65-31954# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center.
METALWORKING Review of Recent Developments
T. G. Byrer and F. W. Boulger 30 Jul. 1965 3 p refs

New developments in metal working are discussed and include extruded and drawn refractory metal H-shaped sections, refractory metal consolidation, fabrication of seamless tubing, improved properties of titanium alloy plate, vacuum forming metal parts, and forming with hydrostatic pressure. R.N.A.

N65-32035*# Princeton Univ., N. J. Dept. of Aerospace and Mechanical Sciences.
THE DESIGN AND DEVELOPMENT OF ROGOWSKI COIL PROBES FOR MEASUREMENT OF CURRENT DENSITY DISTRIBUTION IN A PLASMA PINCH
Edward S. Wright Jun. 1965 36 p refs *Its* Rept.-740
(Grant NsG-301)
(NASA-CR-64582) CFSTI: HC $2.00/MF $0.50 CSCL 14B

Small toroidal Rogowski coil probes have been constructed to measure directly the current density distributions in a large-radius plasma pinch discharge. When properly constructed, the EMF induced in these coils is proportional to the current passing through the center hole of the toroid, irrespective of the details of its distribution. Current density distributions determined by these probes in discharges at various pressures in two different pinch chambers are found to coincide well with the results of detailed magnetic probe mapping over the major portions of the profiles. In particular, current rise and position of current maxima are practically identical, whereas greater variance is noted in current sheet widths, and in measurements close to the chamber wall. On the basis of these results, further use of the Rogowski coil probe for plasma diagnostics seems indicated. Author

N65-32049*# Martin Co., Denver, Colo.
EXPLOSIVE FORMING OF 2219 ALUMINUM Final Report
J. T. Snyder, K. R. Agricola, H. M. Otte, L. I. Van Torne, and R. I. Adler Jun. 1965 136 p refs
(Contract NAS8-11794)
(NASA-CR-64559; CR-65-41) CFSTI: HC $4.00/MF $1.00 CSCL 13H

Parameters affecting metal springback of 2219 aluminum sheet and plate during explosive forming of 1/5-scale gore segments were studied. X-ray diffraction, optical microscopy, and electron microscopy were used to study metallurgical changes occurring as a result of the high energy deformation. Sheet explosive was superior to either bulk Cyadyn 3 or PETN in producing more uniform properties with attendant low springback. The optimum explosive standoff from the viewpoint of uniform properties and lowest springback was 3.54 inches. The materials 2219-T31 and 2219-351 were selected as the optimum tempers for study since they exhibited low springback with attendant uniform mechanical properties. Springback was found to increase with decreasing thickness of 2219-T31. Lubrication of the draw radius before forming also caused an increase in metal springback. The 2219-T37 material did not respond to heat treatment after explosive forming because of internal energy changes caused by high energy deformation. Accelerated aging by a factor of 0.5 resulted from explosive forming. Similar behavior was observed for 2219-T42 and 2219-T31. R.N.A.

N65-32128# Aerojet-General Corp., Sacramento, Calif. Sacramento Plant.
GEMINI LAUNCH VEHICLE Monthly Progress Report No. 28, 1–31 Jul. 1964
10 Aug. 1964 60 p
(Contract AF 04(695)-393)
(Rept.-393-01M-28; AD-462887)

Continued research conducted under a program designed to develop, fabricate, and provide product support for the Gemini Launch Vehicle (GLV) engine system and associated Aerospace Ground Equipment (AGE) is reported. Presented are data on engine design, development tests, the malfunction detection system, the flight instrumentation system, flight operations, aerospace ground equipment, reliability and quality control, pilot safety activities, weight and balance studies, fabrication, and data on the Gemini Value Engineering Program Plan. S.C.W.

N65-32149# Naval Applied Science Lab., Brooklyn, N. Y.
DEVELOPMENT OF WELDING TECHNIQUES FOR FABRICATING A THICK PLATE TITANIUM PRESSURE BOX
[1964] 19 p
(TM-7; AD-617902)

Out-of-chamber, manual, and automatic welding techniques were developed for the construction of a 7 × 7 × 9 inch pressure box. Walls and end closures were made of one-inch thick titanium alloy plate. The shielded inert-gas, consumable-electrode welding process was used. C.T.C.

N65-32186*# Tyco Labs., Inc., Waltham, Mass.
THERMOELECTRIC BONDING STUDY. THE BONDING OF PbTe AND PbTe-SnTe WITH NON-MAGNETIC ELECTRODES
M. Weinstein and H. E. Bates Washington, NASA, Sep. 1965 48 p refs
(Contract NAS5-3986)
(NASA-CR-290) CFSTI: HC $2.00/MF $0.50 CSCL 13H

The major aim of this program is to define clearly the most appropriate system and process for the reproducible fabrication of low resistance, high strength, non-magnetic bonds to PbTe and PbTe-SnTe alloys. During this study we have investigated the applicability of the refractory metals Mo, Nb, Ta, W, and Zr as electrode materials in both diffusion and braze bonding. In conjunction with these refractory metals, SnTe, SnTe-0.1% Fe, $AgSbTe_2$, and $AgBiTe_2$ have been studied as brazes. The Ta-SnTe electrode-braze-composite is the most promising of the various combinations studied. The metallurgical nature as well as the electrical properties of SnTe-Ta braze-bonded PbTe are discussed. A process for the diffusion-bonding of N-PbTe and P-PbTe-SnTe with pure W has been developed. The results of measurements of the thermoelectric properties of bonded and unbonded P and N-type thermoelements are described in detail. Author

N65-32256*# Pratt and Whitney Aircraft, Middletown, Conn.
INVESTIGATION OF CAVITATION DAMAGE OF A MECHANICAL PUMP IMPELLER IN HIGH TEMPERATURE POTASSIUM Quarterly Progress Report No. 2, 1 Mar.–2 Jul. 1965
R. S. Kulp and J. V. Altieri 12 Jul. 1965 21 p refs
(Contract NAS3-6468)
(NASA-CR-54440; CNLM-6031) CFSTI: HC $1.00/MF $0.50 CSCL 13K

This is the second and final quarterly progress report prepared under NASA Contract NAS3-6468 and covers the period March 1, 1965 to July 2, 1965. This contract was terminated as of July 2, 1965, due to closing of CANEL by the Atomic Energy Commission. This report and Quarterly Progress Report No. 1 (NASA CR-54383) completely describe all work accomplished during this program. During this quarter water calibration of the RI-7B3 impeller has been completed. The results check closely with data obtained from the RI-7A3 impeller tests. Design work on the KP-1 turbopump and the Liquid Metal Pump Test Stand has been completed. Fabrication of parts for the turbopump has been completed, and the pump has been assembled. A water test of the turbopump in the Liquid Metal Pump Test Stand has been completed. Radial forces on the impeller have been determined to exist and their magnitude calculated. A two hour acrylic lacquer test run has been completed. Author

N65-32291# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CHEMICAL MILLING
P. T. Rybak and V. V. Savich 16 Jul. 1965 7 p Transl. into ENGLISH from Mashinostroitel', (Moscow), no. 3, 1964 p 34–35
(FTD-TT-65-865/1+2+4; AD-618628)

The principles of chemical etching as an industrial process for removing layers of metal or eroding holes in metal shapes are briefly discussed. Chemical milling assures an accuracy to ±0.05 mm and yields a surface finish comparable to a polishing process. Also, this process can be used in the working of surfaces of complex forms and the process is competitive with machining. Further, the process can be automated. An automatic machine for this process is described. E.E.B.

N65-32300# Watervliet Arsenal, N. Y. Benet R&E Labs.
EXPLOSIVE FORMING OF GUN TUBE SECTIONS
A. A. Campione and V. J. Colangelo Jul. 1964 29 p refs
(WVT-II-6409; AD-608535) CFSTI: $0.75

Application of explosive forming techniques to the fabrication of the 120 mm Heavy Assault Weapon (H.A.W.) gun tube sections resulted in the satisfactory completion of four (4) out of ten (10) tubes in an experimental evaluation. Tubes were radially expanded from tubular blanks of AISI 4140 to the required dimensions, thus eliminating considerable machining time and material cost. The complete fabrication sequence developed on contract has been tabulated for each tube. Room temperature tensile data and impact data at room temperature and −40° F from the minimum and maximum expansion areas are presented for representative tubes. Author

N65-32326# Sandia Lab., Albuquerque, N. Mex.
SOLDERING OF NOBLE METAL ALLOYS
D. S. Sasmor, F. Greulich, H. Romero, and K. E. Mead Aug. 1964 21 p
(Contract AT(29-1)-789)
(SC-DR-64-645)

The interaction and solubility of the noble metal alloy wires (platinum–iridium) with 60%tin–40%lead solder and a bimetallic wire with 94.5%lead–5.5%silver solder were studied, using metallographic techniques and electron probe analyses. The results show that degradation of the mechanical properties of these materials takes place when they are soldered and is due to the formation of low melting eutectics and/or intermetallic compounds which are soluble in the liquid solder. These reactions generally result in a reduction of the wire diameter, embrittlement of the wire, or both. The amount of reaction or the degree of degradation is dependent on (1) the temperature of the molten solder, and (2) the length of time the two materials are in contact when the solder is molten. Although degradation during the solder process needs to be considered during design and carefully evaluated, past experience has shown that these materials can be successfully soldered. Electron probe analyses of samples stored at +165° F for extended periods (up to 4100 hours) indicate that no further measurable degradation between the wire alloys and the solder occurs during elevated temperature storage. Author

N65-32329# California Univ., Livermore. Lawrence Radiation Lab.
EFFECT OF THE TESTING MACHINE ON THE RATE OF EXTENSION (STRAIN) DURING A TENSILE TEST. CHARACTERISTICS OF TENSILE TESTING MACHINES, AND THEIR EFFECT ON THE RATE OF STRAIN AT THE LOWER YIELD POINT
Alfred Krisch and Reinhard Schweitzer Oct. 1964 51 p refs Transl. into ENGLISH from Stahl and Eisen (Germany), no. 83, 1963 p 282–298 *Its* Paper No. 937
(UCRL-TRANS-1138(L))

Analysis of elongation rates measured for soft steel indicate that tensile testing machines of current design are unsuitable for carrying out tensile tests with constant rate of extension in the elastic and plastic regions. Elongation rate measurements made with hydraulic-driven machines show that under some conditions the dimensions and flexibility of the test specimen have a considerable effect on the accuracy of rate measurement. J.M.D.

N65-32346# Joint Publications Research Service, Washington, D. C.
DEVELOPMENTS IN ELECTROSLAG WELDING
B. Ye. Paton, ed. 8 Sep. 1965 52 p refs Transl. into ENGLISH from the book "Novyye Problemy Svarochnoy Tekhniki" Kiev, Acad. of Sci. Ukr. SSr, 1964
(JPRS-31911; TT-65-32405) CFSTI: $3.00

The current state of the art in electroslag welding is reviewed. Particular topics discussed are production of precision weldments, increase in electrode metal melting capacity with reduction in consumption of electrical energy, improvement of austenitic steels and alloys, and development of equipment for electric arc and electroslag welding. J.M.D.

N65-32353# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
AN EXPERIMENTAL HYDROSTATIC JOURNAL BEARING
A. E. Rains 27 Aug. 1965 36 p refs
(Contract AT(29-1)-1106)
(RFP-573) CFSTI: $2.00

The design, fabrication, and testing of a four-pad hydrostatic spindle journal bearing are described. Load cylinder pressure, deflection of each end of the shaft, and the oil temperature were recorded during a number of runs in which the load was varied while a constant source pressure was maintained. Experimental load-deflection was about 7 percent more than predicted by modified calculations of the load-deflection relationship. It was concluded that the basic theoretical deflection assumptions become less applicable as the shaft tilt of the bearing increases. A conservative design approach should include minimized shaft-bending wherever possible. G.G.

N65-32360# Aerojet-General Corp., Azusa, Calif. Production Projects Div.
RELIABILITY: BASIC CONCEPTS
Jul. 1964 34 p refs
(Rept.-2889)

Reliability is considered as a quantitative parameter, and the basic statistical concepts useful in this quantification are discussed. After presenting definitions of reliability, frequency distribution, failure rate, and probability of survival, the relationship between component and system reliability is discussed with examples. Included in this discussion are consideration of redundancy to help prevent system failures due to a single part failure, failure patterns for a system, and the distribution of time between failures. The exponential formula for reliability, the product rule and the exponential formula in reliability prediction, and the evaluation of test data for reliability demonstration are considered. The meaning of "mean time between failures" is discussed. A glossary of terms applicable to the statistical aspects of reliability is appended. M.W.R.

N65-32362# Joint Publications Research Service, Washington, D. C.
DEPRECIATION COSTS OF EQUIPMENT UNDER CONDITIONS OF ITS OPTIMAL UTILIZATION
L. V. Kantorovich Aud and I. V. Romanovskiy 23 Aug. 1965 6 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 162, no. 5, 1965 p 1015–1018
(JPRS-31666; TT-65-32161) CFSTI: $1.00

The problem of replacement of equipment consistent with optimal utilization is studied. A mathematical model, which specifies a varying work load and individual machine capacities which decrease with time, is analyzed from an economic point of view. J.M.D.

N65-32376# Pratt and Whitney Aircraft, Middletown, Conn
BALL BEARING TEST IN LITHIUM
W. D. Richards 15 Jul. 1965 27 p refs
(Contract AT(30-1)-2789)
(TIM-923)

This report describes the results of a liquid metal 40 MM bore ball bearing test which was part of a liquid metal pump development program. The test was conducted for 102 hours in 600F lithium at a maximum rotational speed of 2600 rpm and under a maximum radial load of 40 pounds. Results of this experiment are limited because of a retainer failure after 102 test hours had been obtained. Author

N65-32381# Pratt and Whitney Aircraft, Middletown, Conn.
THRUST BEARING TESTS IN WATER
L. Knudsen Aug. 1965 26 p refs
(Contract AT(30-1)-2789)
(TIM-926)

An orifice compensated double-acting hydrostatic thrust bearing was tested in water. The load carrying capacity was lower than the values predicted by an analysis based on flat plate laminar flow theory. Increases in load carrying capacity resulted with increase of speed at all bearing differential supply pressures below 50 psi. The test bearing laminar region flow rates were within 1.3% of the theoretically predicted values. The 3.2 inch diameter thrust bearing was tested with a .050 inch diameter orifice under differential supply pressures from 25 to 50 psi at speeds from zero to 11,500 rpm and radial loads from zero to 80 pounds. Author

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N65-31299 Joint Publications Research Service, Washington, D. C.
REGIMES IN A QUANTUM OSCILLATOR IN THE PRESENCE OF AN ABSORBING IMPURITY
N. D. Voropayev and A. N. Orayevskiy *In its* Izv. VUZov: Radiofiz., Vol. VIII, No. 2, 1965 10 Aug. 1965 p 253–256 refs (See N65-31275 20-23) CFSTI: $6.00

System illumination for finite values of field amplitude may be investigated with the development of a shut-off device in the circuit of sequential lasers. The buildup of particles to metastable energy levels, with a small value for the dipole moments of the transition, is used to obtain powerful pulses of light radiation in a quantum oscillator in the presence of an absorbing purity. A system of equations is presented which takes into account the absorbing impurity, and a numerical example is considered. The results can be generalized to a specific case when the line width and inverse lifetime of the particles at the level are of inverse magnitudes. M.W.R.

N65-31300 Joint Publications Research Service, Washington, D. C.
EXPERIMENTAL INVESTIGATION OF MODULATION OF A GAS OPTICAL QUANTUM OSCILLATOR
I. G. Goncharov *In its* Izv. VUZov: Radiofiz., Vol. VIII, No. 2, 1965 10 Aug. 1965 p 257–260 refs (See N65-31275 20-23) CFSTI: $6.00

An optical quantum oscillator (OQO) pulse regime with an He-Ne mixture for pulse modulation with respect to supply voltage is investigated for the 0.63 mc line. Circuits were used to permit modulation of the discharge current for both positive and negative voltage pulses. The possibility of pulse modulation of a gas OQO is shown with respect to supply voltage at a repetition rate of 40 kc. Short impulse feeding was not observed because of the large generation time, and a method of obtaining an estimate of this time is developed. M.W.R.

N65-31361 Massachusetts Inst. of Tech., Cambridge.
THE THEORY AND APPLICATION OF MASERS AND LASERS
Charles H. Townes 7 Sep. 1962 *In* Space Technol. Labs., Inc. Selections from the TRW Space Technol. Labs. Lecture Ser., Vol. 2 1965 p 4–13 (See N65-31360 20-34)

Basic operation and frequency characteristics of optical masers are considered. Cesium, helium–neon, and ruby maser oscillator systems are described, and the measurement of the bandwidth of an oscillator is explained. Some applications of masers and lasers are mentioned. M.R.W.

N65-31612# Army Missile Command, Huntsville Ala.
REDSTONE SCIENTIFIC INFORMATION CENTER. LASERS
Gus J. Caras 30 Apr. 1964 46 p refs
(RSIC-195; AD-462245)

The state-of-the-art survey consists of two sections, a technical summary and a bibliography. Although the bibliography deals mostly with the subject of laser pumping, the summary reviews other topics of laser technology including a description of the various types of lasers and their potential applications. Author

N65-31681# Naval Ordnance Test Station, China Lake, Calif. Test Dept.
FABRY-PEROT TYPE LASER MODULATORS Technical Progress Report, Jul. 1963–Jul. 1964
Donald G. Mc Cauley Apr. 1965 45 p refs
(NOTS-TP-3736; TPR-386; AD-617717)

This report describes the optical characteristics of two prototype laser modulators having the thin, flat, disk-shaped Fabry-Perot (F-P) interferometer design. The modulators are being used to investigate the use of laser radiation in communications. The report discusses the intensity modulation resulting both from the converse-piezoelectrically-induced oscillations in the physical separation of the interferometer reflectors and from the electro-optically-induced oscillations in the optical separation of the interferometer reflectors. Author

N65-31836# Hughes Aircraft Co., Culver City, Calif.
[NEODYMIUM GLASS LASERS AND THE GENERATION OF HOLE BURNING SPECTRAL FLUXES] Monthly Report No. 9, 15 Feb.–14 Mar. 1965
L. G. Komai [1965] 37 p
(Contract AF 33(615)-1648)
(AD-464366)

Time-resolved spectral studies of Nd-glass normal lasers were made and suggest that the intricate and diverse details of the spectra observed may be characteristic of hole-burning spectral fluxes generated within the oscillator cavity. The effects on different spectral fluxes were attained using a distant-mirror mode selected oscillator. A considerable range in spectral flux was achieved using a Fabry–Perot spectral compression with thin dielectric-coated microscope glass slips inside the laser. A glan prism in the laser provided a plane-polarized output and the polarization effects were studied. C.T.C.

N65-32069# Korad Corp., Santa Monica, Calif.
GaAs LASER DIODES Quarter Progress Report, 1 Oct.–31 Dec. 1964
R. A. Sehr Ft. Monmouth, N. J., Army Electron. Res. and Develop. Lab. [1964] 21 p
(Contract DA-28-043-AMC-00235(E))
(QPR-2; AD-618464)

This report describes device development work on gallium arsenide injection lasers carried out during the second quarter of the contract period. Particular emphasis was placed on increasing the external power efficiency of the diode laser. In the course of these experiments, laser performance was studied as a function of junction depth, the junction being formed

by Zn diffusion from the vapor phase. Two metallizing methods were tried in order to determine the influence of the surface treatment on laser performance. Twenty lasers fabricated by previously described techniques were delivered in the early part of this reporting period. Author

N65-32203# Cutler-Hammer, Inc., Deer Park, N. Y. Airborne Instruments Lab.
STUDY OF SOLID-STATE AND TRAVELING-WAVE MASER TECHNIQUES Sixth Quarterly Report, Jan.–Mar. 1965
C. Allen, J. De Gruyl, W. Heinz, S. Okwit, and J. Smith Griffiss AFB, N. Y., RADC, Jun. 1965 33 p refs
(Contract AF 30(602)-2989)
(RADC-TR-65-148; AD-618403)

The purpose of this program is to develop improved maser techniques and apply them to a broad-band maser system. The breadboard maser system is in its final stages of fabrication and assembly. Details of the system are described and performance tests will begin shortly. Anamolous limiting effects reported earlier for the semiconductor limiter were found to be caused by relaxation effects in the material. Measurements of a final configuration are presented and a novel pulse modulator mode of operation for the device is described. The Gunn effect in semiconductors has been investigated as a possible pump source for traveling-wave masers. An initial study indicates that this approach to a solid-state pump source may be worthwhile. Author

N65-32298# Centro di Studio per la Fisica delle Microonde, Florence (Italy).
LASER CAVITIES Final Report
R. Pratesi, L. Ronchi, and G. Toraldo di Francia Apr. 1965 84 p refs
(Contract AF 61(052)-720)
(AFCRL-65-481; AD-618468)

A general analysis of the performance of a multiple axial cavity constituted by many ruby rods with plane and parallel surfaces has been carried out. The threshold condition for oscillation has been derived by applying a statistical treatment, and the theoretical results have been checked experimentally. A systematic analysis of the spectral output of the laser radiation was carried out together with an analysis of the spiking structure of the pulse. Far and near field patterns have also been studied. The extension of the multiple axial cavity to geometries other than the plane-parallel is briefly discussed. Finally the application of the multiple axial cavity to the production of giant pulse of enhanced monochromaticity has been tested, using glasses with variable transmission coefficient as light-switches. Author

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N65-31417 European Atomic Energy Community, Brussels (Belgium).
SOME APPLICATIONS OF THE MICROPROBE IN CORROSION STUDIES
H. W. Schleicher *In its* On Electron Microprobe Analysis—Quant. and Structural Analysis of Nucl. Mater. Jun. 1964 p 197–204 refs (See N65-31404 20-06) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 250 Belg. Fr.

Possibilities and limitations are briefly described for the efficient application of the X-ray microanalysator to the study of corrosion problems. Examples are given concerning the corrosion of sintered aluminum powder in terphenyls and water, fouling deposits in organic liquids, and the corrosion of uranium carbide in liquid lead. R.N.A.

N65-31418 European Atomic Energy Community, Brussels (Belgium).
OBSERVATION OF HILLOCKS AND PYRAMIDS ON ALUMINIUM POLYCRYSTALS AND SAP
G. Beghi, E. Patrassi, and G. Piatti *In its* On Electron Microprobe Analysis—Quant. and Structural Analysis of Nucl. Mater. Jun. 1964 p 205–222 refs (See N65-31404 20-06) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 250 Belg. Fr.

Growth of geometric forms during electrolytic polishing of SAP and polycrystalline aluminum with a phosphoric acid and chromic anhydride solution is analyzed. The solution was dominated by the phosphoric acid (90% by weight). Pyramidic and irregular hillock figures were observed in relief on the surface of the specimens, whose dimensions varied from a few microns to about one millimeter at the base. The factors influencing growth are discussed with respect to the material and the physicochemical etching conditions. It is concluded that the pyramids result from some process separate from the etching itself. J.M.D.

N65-31419 Jung (R.), A. G. Heidelberg (West Germany).
PREPARATION OF SPECIMEN FOR ELECTRON MICROPROBE ANALYSIS BY CUTTING WITH A MICROTOME
H. Kirchberg *In* EURATOM On Electron Microprobe Analysis—Quant. and Structural Analysis of Nucl. Mater. Jun. 1964 p 223–225 (See N65-31404 20-06) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 250 Belg. Fr.

A detailed description is presented of a microtome cutting device for use in preparing specimens for electron microprobe analysis. In addition, the microtome's advantages are compared with those of conventional methods. R.N.A.

N65-31440# Bettis Atomic Power Lab., West Mifflin, Pa.
MECHANICAL PROPERTIES OF DEFORMED BINARY ALLOYS OF URANIUM WITH ZIRCONIUM, NIOBIUM, AND MOLYBDENUM
V. K. Grigorovich and A. I. Dedyurin [1963] 13 p refs Transl. into ENGLISH from Stroenie i Svoistva Splavov (USSR), 1963 p 148–161
(WAPD-TRANS-3)

The relationship of mechanical properties to constitution and structure diagrams for binary forged alloys or uranium with 1 to 15 atomic percent zirconium, niobium, and molybdenum was studied. Uranium alloys with 60 to 99 atomic percent zirconium were also considered. The methods of preparation and heat treatment are given, and the hardness and structure are discussed. Tension tests were performed at 500° C, 20° C, and room temperature; creep tests during bend were made between 400° and 600°C. Results indicate: (1) The influence of zirconium, niobium, and

molybdenum on the heat and creep resistance seems to be irregular. (2) Zirconium lowers creep rate more effectively than niobium and molybdenum. (3) With respect to an increase in heat resistance at temperatures of 550° to 580° C, molybdenum, then zirconium, and finally niobium exhibited more effective alloying. C.T.C.

N65-31441# California Univ., Berkeley. Lawrence Radiation Lab.

NEGATIVE CLIMB OF PRISMATIC DISLOCATION LOOPS IN Al–7.2 At.% Mg ALLOY

A. Eikum and G. Thomas Feb. 1964 4 p refs Presented at the 3d European Regional Conf., Electron Microscopy, Prague, Aug.–Sep. 1964
(Contract W-7405-ENG-48)
(UCRL-11239; CONF-806-1)

The negative climb (shrinking) of prismatic dislocation loops in thin foils of Al–Mg alloys was studied using a heating stage in the electron microscope. The activation energy for a negative climb in Al–7.2 at.% Mg was found to be $E_{(-G)}^{b} = 0.68$ eV, and the pre-exponential constant, $A \cong 2.0 \times 10^{-8}$ cm^2/sec. This energy was compared with the values of 1.3 eV for loop shrinkage in pure Al and 0.95 eV measured for loop growth in Al–5.6 at.% Mg. The very low activation energy for a negative climb indicated that the jog energy was extremely small. R.W.H.

N65-31509# Ling-Temco-Vought, Inc., Dallas, Tex.

HYDROFOIL MATERIALS RESEARCH PROGRAM Final Report, 21 Mar. 1961–1 Jul. 1965

A. E. Hohman, W. L. Kennedy, and T. P. Bellinger 1 Jul. 1965 207 p refs
(Contract NObs-84593)
(ER-2-53100/5R-2179; AD-617605)

Sixty materials were studied to determine their suitability for use in construction of high performance hydrofoils and struts. Of these, seventeen materials were given screening tests for susceptibility to sea water corrosion and impingement erosion, and for comparisons of mechanical and fabrication properties. From this work HY-130 low alloy steel and Ti 7Al-2Cb-1Ta titanium were selected for development of design and fabrication data. The HY 130 suitably protected from the sea water environment with a neoprene coating is available for use. The titanium alloy shows many advantages but must have alloy changes to preclude stress corrosion cracking before economic benefits can be realized. Author

N65-31515# Joint Publications Research Service, Washington, D. C.

TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, No. 208: YIELD CONDITIONS IN IDEAL PLASTIC PLANE STRESS PROBLEMS

Ch'end-T'i Chou 23 Aug. 1965 20 p refs Transl. into ENGLISH from Li-hsueh Hsueh-pao (Peking), v. 7, no. 3, Sep. 1964 p 184-194
(JPRS-31649; TT-65-32144) CFSTI: $1.00

Experimental data of initial yield surface is obtained for ideal plastic plane deformation using the Mohr theory and cosine yield conditions. Tresca, Mises, and cosine yield conditions are compared with data from a biaxial extension experiment; and the limit curves of these three yield conditions are illustrated. The magnitude of various characteristics on points of the yield surface is tabulated, and a solution to a polar symmetry plane stress problem is considered. M.W.R.

N65-31538# Iowa State Univ of Science and Technology, Ames.

NEEL TEMPERATURES OF CHROMIUM-VANADIUM ALLOYS FROM NMR MEASUREMENTS

R. G. Barnes and T. P. Graham 28 Oct. 1958 9 p refs Presented at the Magnetism Conf., Minneapolis, Nov. 1964
(Contract W-7405-ENG-82)
(IS-1033; CONF-794-1)

The antiferromagnetic transition temperature of chromium-rich V-Cr alloys has been investigated by means of the extinction of the V^{51} and Cr^{53} NMR signals at the transition temperature in these alloys. Measurements on both natural and isotopically enriched Cr^{53} chromium yield $T_N = 39.0 \pm 0.5°$ C, in excellent agreement with neutron diffraction results. T_N decreases roughly linearly with V content, falling below 4.2° K at 3.4% V. In all cases, the resonance intensity follows the empirical behavior, $I = I_0 \tanh K(1 - T_N/T)$, where $K \approx 15$. At temperatures well above T_N the linewidth and second moment of the Cr^{53} resonance are appreciably larger than the calculated values based solely on nuclear dipolar broadening. These results might be attributed to the persistence of a very small electronic moment in the paramagnetic state. Author

N65-31547# Bettis Atomic Power Lab., West Mifflin, Pa.

ON THE GRAIN GROWTH OF ZIRCONIUM, ZIRCALOY-2, AND TITANIUM IN THE HIGH TEMPERATURE PHASE

H. G. Feller 7 Nov. 1964 6 p Transl. into ENGLISH from Acta Met. (England), v. 12, 1964 p 964–966
(WAPD-Trans-5)

Grain growths of conical zirconium, Zircaloy-2, and titanium samples, with a hole bored along their cone axis, were analyzed after annealing for 30 hrs at 1000° C under a 4×10^{-6} torr vacuum. The maximum grain sizes after normal growth were plotted as linear functions of the corresponding wall thicknesses. All three investigated materials showed locally increasing increments or decrements with increasing grain size. Photomicrographs of thermally etched surfaces from the thin-walled and the thick-walled regions of the zirconium and Zircaloy-2 samples showed pitting and furrowing, respectively, as a result of vacancy formation. Grains with a furrowed morphology occurred at a diameter of 0.4 mm, grains with pits occurred up to a diameter of 0.7 mm. Titanium surfaces were not effected. It was concluded that the furrowed etching depends upon the orientation of the small grains. G.G.

N65-31548# Stanford Research Inst., Menlo Park, Calif.

HIGH TEMPERATURE OXIDATION AND NITRIDATION OF NIOBIUM IN ULTRAHIGH VACUUM Quarterly Report No. V, 1 Jan.–31 Mar. 1964

R. A. Pasternak 15 Apr. 1964 15 p ref
(Contract AT(04-3)-115)
(TID-21114)

Adsorption of nitrogen by a niobium ribbon was studied at room-, intermediate-, and high temperatures under varying pressures. The characteristics of the rates of sorption were the same for all studied conditions: the rates starting with a covered surface increased with temperature and with pressure; they decreased with time, and approached a constant value due to solution equilibrium. Sticking probabilites for a ribbon sample were about twice as high as those for a wire sample of niobium. The solution equilibrium was determined for four concentrations of atomic nitrogen by integration of the high temperature sorption curves. Experimental data from degassing experiments at constant temperatures confirmed the pressure dependence of the solubility and gave correct values for the heat of solution. Adsorption runs with oxygen at ambient temperature and nominal pressure showed a sticking probability curve similar to the nitrogen curve. G.G.

N65-31553*# Hydronautics, Inc., Laurel, Md.
CAVITATION DAMAGE IN LIQUID METALS Technical Progress Report No. 467-3, 1 Apr.–31 May 1965
A. Thiruvengadam, H. S. Preiser, and S. L. Rudy 30 Jun. 1965 33 p refs
(Contract NAS3-4172)
(NASA-CR-54459; TPR-467-3) CFSTI: HC $2.00/MF $0.50 CSCL 11F

Cavitation damage resistance of Stellite 6B, 316 stainless steel, Cb-132M, TZM and T-222 in liquid sodium at 400° F, 1000° F and 1500° F is reported. The test duration is an important parameter in evaluating their relative resistance. Stellite 6B exhibits the best resistance among the metals tested. High frequency fatigue results for 316 stainless steel and TZM in liquid sodium at 1000° F and at 1500° F are presented. The fatigue of 316 stainless steel in 1500° F sodium at 14000 cps is compared with the results obtained in 1500° F vacuum (3×10^{-5} torr) at 4–5 cps and there seems to be good agreement between these results. No stress corrosion cracking of 316 stainless steel was observed in 1000° F sodium up to 100 percent yield over a test period of 60 hours. Author

N65-31566# Bureau of Mines, Rolla, Mo.
THERMAL EXPANSION ANISOTROPY AND PREFERRED ORIENTATION IN ROLLED ZINC ALLOYS CONTAINING COPPER AND TITANIUM
J. T. Dunham, L. E. D. Pease, Jr., and P. G. Barnard Apr. 1965 20 p refs
(BM-RI-6690)

The Bureau of Mines studied by dilatometry the effect of titanium on the thermal expansivity of hot-rolled zinc and Zn-1 percent Cu alloy. The titanium content of the alloys was varied up to 0.3 percent. Expansion coefficients were determined from measurements made both parallel and perpendicular to the plane of the rolled sheet. Titanium reduced expansion parallel to the plane of the sheet, especially in the rolling direction, but increased expansion perpendicular to the sheet. Basal-plane pole figures showed that the degree of preferred orientation increased with the titanium content in the alloy, and that anisotropic expansion can be correlated to sheet texture. Author

N65-31683# Watertown Arsenal Labs., Mass. Industrial Div.
HEAT-TREAT AGING PRACTICE FOR SHELL MOLD CAST 356 ALUMINUM
Emil Toledo and Bryant Crocker Feb. 1965 22 p refs
(AD-617526)

An aging procedure is developed for shell cast 356 aluminum which will permit development of near optimum physical properties. Shell castings were cast into 3/8 to 5/8 in. thick shell molds consisting of 1.6% silica flour, 5% phenolic resin, 30% zirconite, and 63.4% silicon sand. Aluminum ingots were melted in an oil fired furnace in graphite crucibles. Fluxing was accomplished by degassing with proprietary pills for one hour at 1450° F, and by pouring at 1250° F. Heat treatment was by solution annealing at 980° F, quenching in hot water, and room temperature aging at 310° ±10° F for 3 hours. Data on the physical properties vs aging time are tabulated. It is concluded that: (1) aging treatments permit attainment of near optimum physical properties for aluminum shell castings; (2) data developed on aging times for one aluminum casting alloy or process are not always applicable to another; and (3) a wide range of aging times and temperatures will produce near optimum properties for 356 aluminum with less than 0.3% iron. C.T.C.

N65-31711# United States Steel Corp., Monroeville, Pa. Applied Research Lab.
FEASIBILITY OF DEVELOPING AN HY-180/210 WELDMENT Fifth Progress Report
L. F. Porter, A. M. Rathbone, S. T. Rolfe, and K. E. Dorschu 1 Dec. 1964 30 p refs
(Contract NObs-88540)
(S-20000-5; AD-456327L)

Investigations continued on a number of possible approaches for developing HY-180/210 base metals and filler metals. An evaluation of various base metal alloy systems indicates that the 12Ni–5Cr–3Mo type steels exhibit better strength and toughness than the carbon-martensitic age-hardened or the conventional quenched and tempered steels. The most promising approach involves special processing of conventional steels by rapid heat treatment. By this special heat treatment, the yield strength of the 5Ni–Cr–Mo–V steel was raised into the 180 to 200 ksi yield strength range with Charpy V-notch energy absorptions of 62 to 72 ft-lb and with very low transition temperatures. A statistical study of carbon-martensitic filler metals indicates that a yield strength of 180 to 190 ksi and an energy absorption of 40 to 60 ft-lb should be attainable in these weld metals. Results on maraging weld metals indicate that a yield strength of 180 ksi and an energy absorption of 50 ft-lb should be attainable. R.N.A.

N65-31746# Bureau of Mines, Albany, Oreg. Albany Metallurgy Research Center.
QUARTERLY METALLURGICAL PROGRESS REPORT NO 23, APRIL 1–JUNE 30, 1964
[1964] 31 p refs
(Contract AT(11-1)-599)
(USBM-RC-1122)

The determination of selected properties of iron–chromium–gadolinium alloys containing 12, 18, 24, and 30 wt% chromium and up to 5 wt% gadolinium is reported. Recent improvements in hafnium carbide casting technology include a new mold design which has permitted the preparation of tensile bars. The essential component of the design is a segmented center section held together with iron wire. Shortly after pouring the iron wire melts, releasing the center section which allows the casting to shrink without cracking. The determination of electrical resistivity, linear expansion, nitrogen reactivity, and shock resistance properties of sections from hafnium carbide ingots containing free graphite was complted. Also, progress in the determination of the three binary phase diagrams for thorium with praseodymium, neodymium, and holmium is reviewed and new data are presented. Cold-mold induction melting; uranium carbide–uranium nitride–uranium oxide system; cold-mold arc melting; and tungsten–rhenium tubing developments are included. E.E.B.

N65-31754# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center.
HIGH-ENERGY-RATE PROCESSES—REVIEW OF RECENT DEVELOPMENTS
Vonne D. Linse 20 Aug. 1965 4 p refs

Recent developments in chemical high explosive welding, hardening, strengthening, and forming of metals and metal alloys are reviewed. Among the specific fabrications considered was the study of shock effects on the kinetics of isothermal transformation in the explosive strengthening of H-11 steel. The application of a 133.4-kilobar shock load to an austenitized H-11 steel, followed by a double temper, produced a material with a yield strength of approximately 310 000 psi and an ultimate tensile strength of 322 000 psi at 11% elongation. The yield obtained was 70 000 psi higher than the yield

obtained in a control specimen. The 11% elongation is equivalent to that normally found in H-11 steel with approximately 200 000-psi yield. Also, it was found that the general effects of induced shock on certain alloys were to increase tensile strengths by 18 to 107%, to increase hardnesses 49 to 200%, and to reduce impact strengths approximately 30 to 80%. Composition B explosive was found to produce the greatest change in mechanical properties while TNT affected the properties the least. E.E.B.

N65-31797# General Electric Co., San Jose, Calif. Vallecitos Atomic Lab.

GENERAL CORROSION OF MATERIALS FOR NUCLEAR SUPERHEAT APPLICATIONS

W. L. Pearl, E. G. Brush, G. G. Gaul, and G. P. Wozadlo Washington, AEC, Mar. 1965 129 p refs

(Contract AT(04-3)-189)

(GEAP-4760) CFSTI: $4.00

The general corrosion properties of several commercially available materials have been investigated for application as fuel cladding in superheat reactor systems. Each datum point obtained under heat-transfer conditions represented an integrated corrosion response over a temperature gradient along the length of the electrically heated test specimen. An analytical model is developed by which these data may be treated to yield corrosion behavior at a given, specific temperature. Results are reported for a 10 000-hour study of several nickel and stainless steel alloys that were exposed isothermally to 1050° and 1150° F superheated steam. Hastelloy-X, Incoloy-825, Inconel-625, and Incoloy-800 had low initial and long-time linear corrosion rates and formed good protective and tenacious oxides up to 1150° F. Type-406 stainless steel had a high initial but low long-time linear corrosion rate and formed a protective and tenacious oxide up to 1150° F. Inconel-600 had adequate corrosion resistance to 1050° F but formed a nonprotective oxide film with a significant portion lost to the system at 1150° F. Type-304 stainless steel had a significant corrosion rate at 1050° and 1150° F but formed a relatively tenacious oxide at both temperatures that eventually reached a limiting thickness with subsequent spalling. Author

N65-31807# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.

FABRICATION OF URANIUM. INFLUENCE OF FABRICATION ON THE MICROSTRUCTURE AND MECHANICAL CHARACTERISTICS OF URANIUM AND OF SLIGHTLY ALLOYED URANIUM

J. Stohr [1962] 28 p refs Transl. into ENGLISH from a Publ. of the Comm. à l'Energie Atomique, Saclay, France

(AEC-TR-6519)

The influence of fabrication procedures on the microstructure and mechanical properties of technically pure or lightly alloyed uranium, either after the fabrication or after the fabrication followed by tempering or heat treatments, is under study. Included in the evaluation are the quality of uranium and characteristics of the alloys; fabrication by casting procedures, and by plastic deformation methods; and a comparison of the results obtained from each fabrication method. R.W.H.

N65-31827# General Electric Co., Philadelphia, Pa. Reentry Systems Dept.

EVALUATION OF GRAPHITE COMPOSITES IN RE-ENTRY ENVIRONMENTS Progress Report

E. J. Nolan and R. A. Tanzilli Feb. 1965 24 p refs

(Contract AF 33(615)-1768)

(PR-3; AD-463565)

Some preliminary results of the thermodynamic portion of the systems study for a typical ballistic reentry have been obtained on four (4) graphitic material composites. During the third quarter of this study, the experimental portion of the program, which was concerned with the characterization of the oxidation and sublimation behavior of five (5) graphite composites, was completed. A total of 118 tests have been conducted during this experimental phase. Experimental mass transfer data is shown graphically, and comparisons made with theory. An additional test material designated JTA was introduced into this phase of the program to compare its performance with that of the other graphite composites. Markedly, superior oxidation resistance was observed for JTA at low heating rates apparently due to the formation of protective oxide coatings. At higher heating rates, however, no such advantage is observed. Author

N65-31834# General Electric Co., Philadelphia, Pa. Space Sciences Lab.

EVALUATION OF SAPPHIRE WOOL AND ITS INCORPORATION INTO COMPOSITES OF HIGH STRENGTH Quarterly Progress Report, Nov. 15, 1964–Feb. 15, 1965

R. L. Mehan, E. Feingold, and A. Gatti [1965] 46 p refs

(Contract AF 33(615)-1696)

(QPR-3; AD-462869)

This contract is concerned with the mechanical characterization of α-Al_2O_3 wool whiskers in the diameter range of about 0.2μ to 2.0μ and with the incorporation of the wool into high-strength composites. During this quarter, 28 tensile tests were performed on alumina wool. Several improvements were made in the experimental methods for measuring the strength of wool whiskers; the highest tensile value obtained was 6.2×10^6 psi. A method was developed which allows electron micrograph replicas to be obtained on these wool-type whiskers. Finally, composites of alumina wool in an aluminum matrix were made, with good wetting being obtained between the matrix material and the fibers. No mechanical tests on these composites have been performed to date. Author

N65-31839# Ling-Temco-Vought, Inc., Dallas, Tex.

INVESTIGATION AND DEVELOPMENT OF TECHNIQUES TO EXTEND THE UTILITY OF PACK PROCESSES AND COMPOSITIONS FOR COATING MOLYBDENUM AND COLUMBIUM ALLOYS First Quarterly Progress Report, 1 Jun.–1 Sep. 1964

W. L. Aves, G. Bourland, and G. M. Ecord [1964] 73 p refs

(Contract AF 33(615)-1678)

(Rept.-2-53052/4R-2147; AD-463562)

Progress is reported on the program to extend the utility and versatility of the pack cementation process. Work accomplished included an enumeration of problem areas associated with, an evaluation of methods to improve, and an investigation of modifications of the conventional process. Methods of improving the conventional process included a study of the thermodynamic properties of a large number of possible halide activators for deposition of coating elements, an evaluation of the use of inert powders and lightweight ceramic materials as space fillers in the retort, and an evaluation of the use of internal conductors in relatively large retorts to increase the heat transfer rate during heating and cooling. Coatings with six different compositions were deposited on three refractory alloys, TZM molybdenum, B-66 niobium, and D-43 niobium. Preliminary results indicated that at least one coating system deposited on each refractory metal is protective for periods of 8 hours at 2500° F. E.E.B.

N65-31850# Naval Applied Science Lab., Brooklyn, N. Y. Material Sciences Div.
FATIGUE OF IRON BASE ALLOYS HY-80 STEEL CAST TEES BUTT WELDED TO ROLLED SECTION SINGLE AND DOUBLE WELD JOINT DESIGN
14 Dec. 1964 20 p refs
(TM-19; AD-461360)

Results of fatigue tests of HY-80 steel cast tees butt welded to rolled plate are summarized. The average fatigue life of 1-5/8-inch thick cast tee butt welded to rolled plate is approximately the same as that of cast plate butt welded to rolled plate and rolled plate butt welded to rolled plate. At 80000 psi nominal stress range the fatigue life of these butt welds is about 20000 cycles. No significant difference in the fatigue life of single and double vee butt joints can be estimated because the differences in fatigue life represent normal scatter of fatigue data and because the amount of data is limited. E.E.B.

N65-31865# Battelle Memorial Inst., Columbus, Ohio.
STRUCTURAL CHANGES IN HIGH-STRENGTH STEEL ASSOCIATED WITH STRESS CORROSION AND ITS RELATIONSHIP TO DELAYED FAILURE Summary Report, 29 Jun. 1964–29 Jun. 1965
D. I. Phalen, D. A. Vaughan, A. B. Tripler, Jr., W. K. Boyd, and C. M. Schwartz 21 Jul. 1965 21 p refs
(Contract NOw-64-0267-c)
(AD-468171)

Studies of the structural changes associated with stress corrosion and delayed failure in AISI 4340 steel have shown that significant changes take place in both the internal structure and the fracture-surface morphology as a result of specific treatments, particularly the cathodic portion of the corrosion reaction. The incipient stage of stress cracking may be the result of stress corrosion, hydrogen embrittlement, or both, inasmuch as either corrosion or cathodic charging regenerates visible stacking faults in martensite. The regeneration of these stacking faults is believed to be the cause of transgranular fracture in the initial stages of stress-corrosion cracking. Examination of the fracture-surface morphology of stress-corrosion cracked and hydrogen-cracked alloys indicates that, after the initial reaction, hydrogen diffuses to and along prior-austenite grain boundaries and causes intergranular failure. The most likely mechanism for intergranular failure appears to be reduction of prior-austenite grain boundary energy as a result of adsorbed hydrogen. The analysis of fracture morphology of stress-corrosion failures is compared with that of a hydrogen-cracked fracture surface modified by a subsequent anodic treatment in the corrosion medium. Author

N65-31890# Union Carbide Research Inst., Tarrytown, N. Y.
PRINCIPLES GOVERNING THE BEHAVIOR OF SOLID MATERIALS IN SEVERE HIGH TEMPERATURE ENVIRONMENTS Quarterly Progress Report, 8 Mar.–30 Jun. 1965
S. R. Aspinall 30 Jun. 1965 62 p refs
(Contract DA-01-021-AMC-11926(Z))
(AD-466458)

The reaction between high density tungsten and H_2O vapor was studied from 1900° to 2800° K in the induction heated stagnation flow reactor at H_2O partial pressures from 25 to 155 torr. Rate data previously obtained for the W–CO_2 reaction are being analyzed in terms of a model including diffusion effects, reaction of the oxygen formed by cracking of CO_2, and activated sticking of CO_2 on the tungsten surface. Difficulties traceable to the slow reaction of W with HF were encountered in studying the W–HF reaction in the arc image stagnation flow reactor. Relative rates of production of gaseous O, WO, and WO_2 by the W–O_2 and W–CO_2 reactions were studied by mass spectrometry. Two tungsten nozzle inserts and holders instrumented with thermocouples were completed. Additional transverse rupture strength data confirm the desired behavior of the TaC–Ag skeletal composites. Vaporization of silver from and chemical corrosion of TaC-Ag composites and commercial W–Ag composites were studied in the arc image reactor. Skeletal carbides using Ni as an infiltrant do not maintain their strength at temperatures approaching the melting point of nickel. R.N.A.

N65-31937# Solar, San Diego, Calif.
DEVELOPMENT OF COMPOSITE STRUCTURES FOR HIGH-TEMPERATURE OPERATION Second Interim Technical Report, 1 Nov. 1964–28 Feb. 1965
R. Licciardello [1965] 69 p refs
(Contract AF 33(615)-1831)
(ER-1480-9; AD-461369)

Results of optimization studies on the tungsten–thoria composites are reported. These consist of expansion-shrinkage studies, bend strength tests, and thermal shock resistance tests. The same tests are used to develop and evaluate a second composite system in which hafnia replaces thoria. Some ductile refractory alloys were evaluated as alternates to tungsten for substrate materials. Preliminary design analyses are presented for a high-temperature combustion heater test facility based on a Marquardt SUE burner. Theoretical combustion studies for two fuels with oxygen are reported. Author

N65-31949# Mechanical Technology, Inc., Latham, N. Y.
THE EFFECT OF INELASTIC TENSILE PRESTRAIN ON THE BRITTLE FRACTURE PROPERTIES OF ANNEALED 4140 STEEL
D. W. Mc Laughlin 6 May 1965 54 p refs
(Contract DA-44-009-AMC-723(X))
(MTI-65TR21; AD-467591)

An experimental study is reported that determines the effect of increasing amounts of inelastic tensile prestrain on the brittle fracture behavior of annealed AISI 4140 steel. Fracture characteristics of both prestrained and unstrained material were measured with V-notch Charpy specimens and drop-weight specimens. Specimens were prestrained to 1.3, 2.7, and 7.8 percent inelastic strains. Significant changes were observed in the slope, upper energy shelf and temperature location of the Charpy energy-temperature curve. The nil-ductility transition temperature (NDT), NDT energy "fix," and the Charpy fracture appearance curve also were affected markedly by inelastic prestrain. An introductory review of brittle fracture is presented. Emphasis is given to the transition temperature method of fracture analysis and to the design approach embodied in the Fracture Analysis Diagram developed at the U. S. Naval Research Laboratory. The design significance of the experimental data is interpreted in terms of their effect on the Fracture Analysis Diagram. Author

N65-31996# Naval Research Lab., Washington, D. C.
OBSERVATIONS MADE AT THE ROOT OF A NOTCH IN IRON FATIGUED IN BENDING
D. A. Meyn, C. D. Beachem, and T. C. Lupton May 1965 23 p refs
(NRL-Memo-1614; AD-617332)

A piece of iron wire was notched to a depth of .030", polished and etched, and then cycled by reversed plane bending. Plastic replicas were made of the notch root after the completion of each tensile stroke. A long trough or crack, about 20 microns deep and 20 microns wide was observed to develop during 7-1/4 cycles. Various effects of cyclic plastic

flow were observed in detail at and near the notch root, including the formation of slip bands and subsequent fissuring in the slip bands, and the sinking of surface material to form troughs during cycling. Author

N65-32016# Lockheed Missiles and Space Co., Sunnyvale, Calif.
SOME PECULIARITIES OF THE DYNAMIC STRAIN OF ALLOYS
S. A. Kisliakov and N. F. Kunin [1965] 3 p refs Transl. into ENGLISH from Dokl. Akad. Nauk Belorussk. SSR, v. 9, no. 3, 1965 p 164–166

The induced changes in the residual properties of 0.98 mm thick alpha-brass wires during and after impact strain were investigated at strain temperatures of 80° to 623° K. Dynamic coefficients of the induced thermoelectromotive force and the induced resistivity differed slightly for a 20 percent relative deformation in the observed temperature range, and were in the order of 1.1 to 1.2. This verified the assumption of a greater athermality in alloys as compared with pure metals. G.G.

N65-32065# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
THE SIGMA PHASE AND ITS METALLOGRAPHIC IDENTIFICATION IN TYPE 310 STAINLESS STEEL
R. Roberge and V. B. Lawson Mar. 1965 46 p refs
(AECL-2234) Available from Atomic Energy of Canada, Chalk River: $1.00

A literature review of the Sigma phase and its effects on the room and elevated-temperature mechanical properties of stainless steels is presented. Included is a review of identification methods. The known etchants and their action on Sigma particles has been investigated. The best etchant for the identification of Sigma in type 310 stainless steel was found to be an electrolyte of 10 N potassium hydroxide in which the specimen was etched anodically for 5 seconds at 1.5 volts. Author

N65-32067# Air Reduction Co., Inc., Murray Hill, N. J. Research and Engineering Dept.
MARAGING STEEL FILLER METALS: THE EFFECT OF WIRE PROCESSING TECHNIQUES, MAY 1964–FEBRUARY 1965
16 Mar. 1965 26 p refs
(Contract NObs-88540)
(RE-65-021-CRE-34; AD-467858)

It has been shown that (1) variations in the gas contents of differently prepared filler metals studied in this program is not related to melting practice but to wire processing techniques; (2) both direct vacuum-melting and vacuum-remelting produced filler metals with low interstitial gas levels; and (3) reduction of filler metal oxygen and hydrogen contents does not necessarily improve the weld metal toughness, that is interstitial gases introduced through the filler metal did not cause a degradation in weld properties. Because of the restrictions placed on control of residuals in maraging steels a wire surface free of contamination is preferred for these filler metals. However, in this work it was not found to be as critical as previously suspected with regard to weld toughness. Future work is planned to determine the effect of surface contamination on filler metals known to be of ultra-high purity. Author

N65-32132# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center.
BERYLLIUM-REVIEW OF RECENT DEVELOPMENTS
Hugh D. Hanes 31 Jul. 1964 6 p refs
(AD-460865)

Recent metallurgical developments are reviewed on beryllium joining, mechanical properties, melting, casting, wire, and structures. Studies are included on solder compositions, fluxes, and soldering procedures for beryllium, joining of beryllium plates by braze welding; the effect of heat treatment on the tensile and creep properties of hot pressed warm extruded beryllium; casting and hot working of sound large diameter beryllium ingots; improved fabrication techniques for producing long continuous lengths of beryllium wire; diameter effect on tensile strength of fine beryllium wire; and the fabrication of beryllium composites. R.N.A.

N65-32135# Army Missile Command, Huntsville, Ala. Solid Propellant Chemistry Branch.
RAPID CONTROL ANALYSIS OF 18-PERCENT NICKEL MARAGING STEELS BY X-RAY SPECTROMETRY
Bernard J. Alley 15 Jun. 1965 22 p ref
(RK-TR-65-5; AD-467156)

Rapid, nondestructive X-ray spectrometric procedures were developed for the analyses of molybdenum, manganese, titanium, nickel, cobalt, aluminum, and silicon in the 18-percent nickel maraging series of steels. Regression equations relating characteristic X-ray intensity ratios and corresponding element percentages were derived by assuming a simple linear regression model which neglects matrix effects. Element percentages in unknown steel samples are estimated either from graphs of the regression equations or the inverse working equations. Since primary standards were not available for calibration, the suitability of the method was assessed by the goodness of fit of the assumed model to the data. The method is considered suitable for checking the compositions of 18-percent nickel maraging steels. Author

N65-32150*# Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy.
ThO_2 DISPERSION-STRENGTHENED Ni AND Ni–Mo ALLOYS PRODUCED BY SELECTIVE REDUCTION
Jens G. Rasmussen and Nicholas J. Grant (Ph.D. Thesis) Jun. 1964 40 p refs Presented at the Powder Met. Symp. of the Joint Comm. on Powder Met. of the J. of Iron and Steel Inst. and the Inst. of Metals, London, Oct. 1964 Submitted for Publication
(Grant NsG-117-61)
(NASA-CR-59399) CFSTI: HC $2.00/MF $0.50 CSCL 11F

A series of Ni–ThO_2 and Ni–12Mo–ThO_2 alloys, containing from 3 to 9 volume percent thoria, were prepared by selective hydrogen reduction of mixed submicron oxides. Considerably higher than usual room temperature strength properties with good ductility were obtained. At 932° C, creep-rupture properties were excellent, with significant improvements in strength and stability due to solid solution strengthening of nickel by 12 weight percent molybdenum. Investigated were the benefits derived from additional cold work after hot extrusion, with and without intermediate annealing treatments. An analysis of the probable strain distribution in oxide dispersion-strengthened alloys is presented. Author

N65-32170*# Rice Univ., Houston, Tex.
ORIENTATION EFFECTS IN THE DEFORMATION OF MOLYBDENUM CRYSTALS

D. L. Davidson and F. R. Brotzen [1963] 9 p refs Submitted for Publication
(Grant-NsG-6-59)
(NASA-CR-59337) CSCL 11F

An investigation was conducted on the orientation effects in zone refined molybdenum single crystals deformed in tension and in direct shear. Results indicate that the plastic deformation mechanisms in molybdenum are orientation dependent and involve interactions affected by the stress state.
R.N.A.

N65-32184*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INFLUENCE OF ORDER-DISORDER TRANSFORMATION ON FRICTION CHARACTERISTICS OF COPPER-GOLD ALLOYS IN VACUUM
Donald H. Buckley Washington, NASA, Sep. 1965 13 p refs
(NASA-TN-D-2985) CFSTI: HC $1.00/MF $0.50 CSCL 11F

The influence of order and the order-disorder transformation for copper-gold alloys on friction was determined in vacuum. The copper-gold alloys contained 10, 25, or 50 atomic percent gold. The latter two alloys are the compounds Cu_3Au and CuAu. Both Cu_3Au and CuAu exhibit ordering, while the 10 atomic percent gold in copper does not. Friction experiments were conducted in vacuum (10^{-9} mmHg) with a hemispherical rider specimen of the copper-gold alloy sliding on itself or 440-C stainless steel. The specimens were examined under loads of 1000 grams, sliding speeds to 880 centimeters per second, and temperatures to 400° C. The results of these studies indicate lower coefficients of friction for the alloys Cu_3Au and CuAu in the atomically ordered state than for these alloys in a disordered state. The 10-atomic-percent-gold alloy, which does not become ordered, did not reflect any marked changes in friction when examined under conditions similar to those for Cu_3Au and CuAu. Author

N65-32188*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
LOW MECHANICAL PROPERTIES OF HP 9-4-25 ALLOY
W. R. Morgan 23 Jul. 1965 17 p refs
(NASA-TM-X-53302) CFSTI: HC $1.00/MF $0.50 CSCL 11F

The mechanical properties of HP 9-4-25 alloy sheet (0.062-inch thick) were determined at temperatures from 27° C (80° F) to −253° C (−423° F) The ultimate tensile and yield strengths were considerably greater at −253° C (−423° F) than at 27° C (80° F), and the notched/unnotched tensile ratios were greater than 0.81 at temperatures from 27° C (80° F) to −196° C (−320° F). This alloy is not recommended for critical applications below −196° C (−320° F) since the elongation and notched/unnotched tensile ratio decreased rapidly below this temperature. Author

N65-32206# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF CERTAIN ELEMENTS ON THE PLASTICITY OF NICKEL AT HIGHER TEMPERATURES
G. M. Volkogon and I. L. Rogel'berg 7 Jul. 1965 13 p refs Transl. into ENGLISH from Tsvetn. Metal. (Moscow), no. 6, 1964 p 66–71
(FTD-TT-65-328/1+2+4; AD-618012)

Experimental meltings were carried out in the induction high frequency furnace in a rammed crucible of pure melted magnesite. A batch of cathode nickel type HO and ligature Ni-C(1.8% C) was used, prepared from nickel of the same type. Additions were introduced in the form of pure metals, and in the form of legatures (Ni-Mg, Si-Ca, Ni-B). The metal was melted under a solid layer of acid slag and deoxidized with 0.15% C. More additions were introduced wrapped in nickel foil after attaining 1520°–1540° C. Temperature was controlled by platinum–platino rhodium thermocouple, protected by a quartz tip for single submersion. Prior to pouring, the liquid metal was exposed for 1 minute. Mechanical properties of Ni were investigated in a hot rolled state. Plasticity characteristics were determined on samples with diameters of 6 mm and a calculated length of 30 mm, at a rate deformation of 3.5 mm/min with temperatures of 20°, 200°, 500°, 600°, 700°, 800°, 900°, 1000°, and 1100° C. The effect of the additions on plasticity of nickel is explained on the basis of ideas concerning the binding of harmful admixtures into stable and high melting compounds. R.W.H.

N65-32254*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
STRESS CORROSION STUDIES OF AM-355 STAINLESS STEEL
J. G. Williamson 9 Aug. 1965 22 p
(NASA-TM-X-53317) CFSTI: HC $1.00/MF $0.50 CSCL 11F

The stress corrosion cracking susceptibility of AM-355 stainless steel alloy was studied. This alloy is used extensively for sleeves in flared tube fittings in the S-I and S-IC stages of the Saturn I and Saturn V vehicles, respectively. Various heat treated conditions were investigated and relative stress corrosion cracking susceptibility determined. Of the generally used heat treatments, the fully hardened SCT 1000 treatment was found to be superior in stress corrosion resistance. Author

N65-32271*# National Aeronautics and Space Administration, Washington, D. C.
THE EFFECT OF THE CONDITION OF THE SURFACE LAYERS ON THE CHARACTERISTICS OF THE REFRACTORY ALLOYS EI 437 AND EI 617 [VLIV STAVU POVRCHOVYCCH VRSTEV NA VLASTNOSTI ZARUPEVNYCH SLITIN EI 437 A EI 617]
Jiri Havlicek Aug. 1965 15 p refs Transl. into ENGLISH from Zpravod. Vyzkumny a Zkusebni Letecky Ustav (Czech.), no. 6, 1964 p 45–49
(NASA-TT-F-9507) CFSTI: HC $1.00/MF $0.50 CSCL 11F

Current knowledge is reviewed concerning the effect of mechanical machining on the characteristics of the E1437 and E1617 nickel-base heat-resistant alloys, designed for the production of turbine blades. Machining tends to cause the hardening of the surface layers, which then differ from the core of the blade. The effect of different machining methods on the condition of the surface layers is compared, and data are included showing these differences as well as changes occurring during the individual steps of the machining process. Author

N65-32283# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON METHODS OF MEASUREMENT OF MICROHARDNESS ON ANISOTROPIC CRYSTALS
V. A. Kokoshkin 14 Jul. 1965 15 p refs Transl. into ENGLISH from Tr. Inst. Met. Akad. Nauk SSSR (Moscow), no. 11, 1962 p 114–119
(FTD-TT-65-254/1+2+3+4; AD-618636)

Specially shaped indenters are proposed for measuring the hardness of anisotropic crystals, and for referring the measured value to definite crystallographic planes. It is pointed out that maximum conformity between the shapes of the indenter and of the indentation should be observed, as microhardness

is characterized by average contact pressure or specific deformation. Advantages of the proposed method are summarized as increased accuracy, with fewer errors due to distortion of the shape of indentations and the appearance of cracks; and as offering the possibility for more detailed studies of the anisotropy of crystal substances. M.G.J.

N65-32286# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STUDY OF BERYLLIUM AND CHROMIUM WHISKERS
V. M. Amonenko, B. M. Vasyutinskiy, G. N. Kartmazov, I. I. Papirov, G. F. Tikhinskiy et al 12 Jul. 1965 8 p refs Transl. into ENGLISH from Issled. po Vysokoprochnym Splavam i Nitevidnym Kristallam, Dokl. na Nauchnoy Sessii, 1962, Akad. Nauk SSSR, 1963 p 34–36
(FTD-T-65-339/1+2+4; AD-618630)

The growing of beryllium and chromium whiskers through condensation from the vapor phase in a vacuum is described. The growth of crystal whiskers of beryllium was observed at evaporation temperatures from 1365° to 1600° C and of chromium at 1320° to 1460° C. X-ray examination showed that all specimens were monocrystalline. The dependence of the strength of the crystal whiskers of chromium on the cross sectional area for 40 specimens is shown. The maximum value for the rupture strength was 270 kg/mm^2 for a specimen with cross sectional area of 2×10^{-5} mm^2. E.E.B.

N65-32316# Case Inst. of Tech., Cleveland, Ohio.
ANNEALING OF STRESS ANISOTROPY IN THIN IRON FILMS Technical Report No. 32
J. Riesenfeld Mar. 1964 23 p refs
(Contract AT(11-1)-623)
(TID-21326)

A study has been made of the effect of annealing on stress and stress anisotropy in thin iron films. The films were deposited at oblique incidence in the thickness range 200–800 A and annealed in vacuum in steps up to 200° C. Before annealing, the ratio of the stress in the plane of incidence to the stress perpendicular to this direction ranged from 0.9 for the thickest films to 2.0 for the thinnest. On annealing, both the stress and stress ratio decreased for all thicknesses, the stress ratio in every case falling below 1.0 after annealing at 200° C. The annealing behavior is explained on the basis of the elimination of some crystallite boundaries and a reduction in thickness independent tensile stress. Author

N65-32321# General Dynamics Corp., San Diego, Calif. General Atomic Div.
A PROGRAM OF BASIC RESEARCH ON MECHANICAL PROPERTIES OF REACTOR MATERIALS Quarterly Progress Report, Period Ending 31 Jul. 1964
R. H. Chambers and T. A. Trozera 26 Aug. 1964 15 p refs
(Contract AT(04-3)-167)
(GA-5620)

The properties and growth of high-purity bcc metal crystals for neutron irradiation are discussed. Tungsten was chosen for the irradiations and work has progressed very well on the preparation of single crystals of suitable purity. Specimens grown have been zone-refined in system pressure as low as 5×10^{-8} torr. Also, the information available on the effects of relatively low-temperature annealing or aging on the deformation-induced damping peaks is reviewed and new results on deformed niobium are presented which show additional pinning effects. None of the deformation-induced peaks of the four refractory bcc metals are removed by annealing at room temperature. Measurements were made of the amplitude-independent, temperature-dependent damping and modulus of a plastically deformed, relatively high-purity niobium wire specimen that was first plastically deformed at about 25% at 300° K and then annealed at 500° K for one-half hour. Following the anneal, the specimen was held at 78° K and twisted at a strain rate of about 1×10^{-6} sec^{-1} until about 0.25% permanent set developed. Results are shown. E.E.B.

N65-32322# Virginia Polytechnic Inst., Blacksburg. Dept. of Metallurgical Engineering.
THE RELATIONSHIP OF NITROGEN CONTENT OF AUSTENITIC STAINLESS STEELS TO STRESS CORROSION Quarterly Report No. 1, 1 Jun.–30 Sep. 1964
Brownell N. Ferry 30 Sep. 1964 12 p refs Co-Sponsored by EURATOM *Its* Rept.-438-1
(Contract AT(40-1)-3208)
(EURAEC-1216)

Progress is reported on an investigation to determine the mechanism by which nitrogen affects the susceptibility of austenitic stainless steels to stress corrosion. Emphasis was placed on the following: (1) design and construction of a new nitriding facility; (2) design and construction of chromium and nickel plating apparatus; (3) formulation of procedures for plating nickel and chromium on iron wires; and (4) refinement of the torsional pendulum to facilitate operation. E.E.B.

N65-32323# Laboratoires du Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).
STUDY OF ZIRCONIUM-RICH ALLOYS OF THE ZIRCONIUM–NIOBIUM–CHROMIUM AND ZIRCONIUM–NIOBIUM–VANADIUM SYSTEMS
U. Benedict and J. J. Huet 1964 10 p refs Transl. into ENGLISH from Z. Metalik. (Stuttgart), v. 55, no. 5, 1964 p 261–265
(Contract EURATOM 027-60-07 RDB)
(EUR-1317.d; EURAEC-717)

Investigations are reported which show that the partial zirconium–niobium–zirconium-2% vanadium and zirconium–niobium–zirconium-2% chromium diagrams can be interpreted as ternary eutectoids. A metastable beta phase may be retained by quenching in ternary alloys and in zirconium–vanadium alloys within specific concentration ranges but not in zirconium–chromium alloys within the investigated range of concentration. E.E.B.

N65-32339# California Univ., Berkeley. Lawrence Radiation Lab.
RADIATION EFFECTS ON NOBLE METALS Bibliography
Brigitta M. Dobratz 14 Apr. 1964 18 p
(Contract W-7405-ENG-48)
(UCRL-7810)

N65-32347# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.
MICROSTRUCTURAL EVALUATION OF SUPERHEAT CLADDING MATERIALS
F. A. Comprelli and J. E. Lewis Washington, AEC, Jan. 1965 63 p refs
(Contract AT(04-3)-189)
(GEAP-4751) CFSTI: $3.00

Data are presented which describe the thermal response characteristics of selected superheat alloys. The alloys include Incoloy-800, Incoloy-801, Incoloy-804, Incoloy-825, Type

310 stainless steel, Hastelloy-N, Hastelloy-F, Inconel-625, Inconel-718, and a G.E.-Modified Incoloy-800. Each alloy was evaluated by monitoring the room temperature hardness after exposure for various time intervals at 1200 or 1400° F. Light microscopy was used to monitor microstructural changes. Precipitate phases were identified by x-ray diffraction. Relative amounts of elements in each phase were determined by x-ray fluorescence. Author

N65-32351# Battelle Memorial Inst., Columbus, Ohio.
STRUCTURAL CHANGES IN HIGH-STRENGTH STEEL ASSOCIATED WITH STRESS CORROSION AND ITS RELATIONSHIP TO DELAYED FAILURE Quarterly Progress Report, Jun. 29–Sep. 28, 1964
D. A. Vaughan, D. I. Phalen, A. B. Tripler, and C. M. Schwartz
23 Oct. 1964 9 p
(Contract NOw-64-0267-c)
(QPR-1; AD-617785)

The investigation of structural characteristics of AISI 4340 steel, quenched and tempered to produce three strength levels, has been initiated as a basis for the planned studies of these materials under conditions of stress-corrosion attack. Due to problems in contract negotiation, this program was delayed in starting. However, the experimental work, plus a literature study, has been initiated. Preliminary electron metallographic studies of the steel have been carried out in the process of developing techniques. Electron diffraction and X-ray diffraction results are being correlated with the microstructure. Author

N65-32361# Pratt and Whitney Aircraft, Middletown, Conn.
DEVELOPMENT OF Cb–Zr–C ALLOYS
E. J. Delgrosso, C. E. Carlson, and J. J. Kaminsky Sep. 1965
64 p refs
(Contract AT(30-1)-2789)
(PWAC-464)

A series of high strength columbium alloys were developed by adding stoichiometric concentrations of zirconium and carbon at the one to three percent atomic level. The alloys are characterized by good strength at elevated temperatures and a high degree of fabricability; and rupture data indicated three of the alloys to be strongest in the warm extruded condition, exhibiting a duration limit of 150 to 400 hours at 1315° C under a 9000 psi loading stress. While subsequent cold working reduced this strength, proper heat treatment brought about an almost complete regain. An alloy containing Cb–1 Zr–0.1 C was selected as first choice for application to the SNAP-50 program. Tabular data presented for the many alloys developed include composition, arc melting practice, fabrication history, and mechanical properties. Structures of two of the extruded alloys are illustrated and yield strengths are diagrammed. Other data include carbide phases extracted, weld bend, and effect of heat treatment. Fabrication schedules are illustrated. M.W.R.

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N65-31719# Naval Civil Engineering Lab., Port Hueneme, Calif.
DEGRADATION OF ORGANIC COATING BY IRRADIATION WITH LIGHT. III: VOLATILE PRODUCTS FROM SIMULATED SOLAR IRRADIATION IN AIR
Peter J. Hearst 10 Jun. 1965 40 p refs
(N-729; AD-617244)

Various clear vehicle films were irradiated in air with a xenon arc and the volatile products were identified by infrared spectroscopy. The films included alkyd, oil, vinyl-alkyd, vinyl, vinyl acetate, epoxyamine, and epoxy-polyamide films. The volatile products obtained were qualitatively similar to those obtained by mercury arc irradiation of the same films, but the relative amounts of the various products were changed in many cases. The products from the mercury arc irradiation contained acetylene but those from the xenon arc irradiation did not contain acetylene. These differences in the products show that the more rapid deterioration in the ultraviolet light from the mercury arc differs from the deterioration obtained in the simulated sunlight from the xenon arc. Author

N65-31790# Dynamic Science Corp., South Pasadena, Calif.
RHEOLOGY OF SILICONE FLUIDS THICKENED WITH BORON NITRIDE Quarterly Report, 15 Mar.–15 Jun. 1964
15 Jun. 1964 43 p
(Contract AF 33(657)-9155)
(QR-7; AD-463706)

The rheological properties of a grease thickened by boron nitride can be improved substantially if the thickener is composed of submicron size particles instead of relatively coarse grains characteristic of commercial grade material. The submicron material is being prepared by gas phase reaction of ammonia and boron trichloride under high nitrogen dilution at a temperature of 900° C. Purification is being effected by vacuum sublimation of the by product ammonium chloride. Three boron nitrides manufactured during the current program have been used to thicken Qf 6-7039 silicone fluid; one boron nitride has been used to thicken MLO 60-231 60 ether; in addition, one boron nitride has been used to thicken a proprietary fluid. Measurements of consistency as a function of solid/fluid ratio have been carried out for most grease samples. Rheological tests have been conducted on three greases at temperatures of 77° and 600° F. Future work comprises the following: (1) Completion of boron nitride synthesis by gas phase reaction; (2) Boron nitride synthesis by decomposition of borazine; (3) Completion of penetration and rheological tests on all greases, and (4) Studies of unconventional grease-blending techniques. Author

N65-31801# Radiation Applications, Inc., Long Island City, N. Y.
UPGRADING OF BY-PRODUCT POLYPROPYLENE BY RADIATION TECHNIQUES Final Summary Report, 1 Feb. 1964–31 Jan. 1965
Bruce S. Bernstein, Joseph Lee, and Gyula Orban Washington, AEC, 15 Mar. 1965 67 p refs
(Contract AT(30-1)-3333)
(RAI-3333-1) CFSTI: $3.00

Upgrading techniques used to improve the physical and mechanical properties of by-product polypropylene, obtained as a waste product during the preparation of stereoblock homopolymer, are discussed. Analyzed were the following three types of non-stereo-regular polypropylene from different sources: a relatively low molecular weight grade primarily atactic in nature; a true by-product of intermediate molecular weight containing some stereoregular portions; and an experimental high molecular weight material solely atactic in nature. Evaluated were the effects of by-product residual crystallinity and molecular weight;

and the effects due to polyfunctional monomer nature and level, reinforcing agent nature, and radiation dose. Included is a discussion of the potential applicability of the processes described. S.C.W.

N65-31873# Watervliet Arsenal, N. Y. Benet Labs.
EFFECT OF FIBER GEOMETRY ON STRESS IN FIBER-REINFORCED COMPOSITE MATERIALS, PHASE I
Thomas F. Mac Laughlin and Michael J. Salkind May 1965 20 p ref
(WVT-6521; AD-616520)

Five photoelastic models of fiber-reinforced composite material configurations were designed for the purpose of investigating the effects of various fiber end shapes and broken fibers on the shear stress distribution in an elastic matrix. Maximum shear stresses along fiber boundaries in the vicinity of fiber discontinuities are presented. Stress distributions resulting from square-ended, round-ended and pointed fibers were found to be similar. Peak stresses in "broken" fibers were about twice as high, and decreased with increasing gap length between fiber ends Author

N65-31935# Princeton Univ., N. J. Frick Chemical Lab.
VOLUME DILATATION AND ENERGETIC STRESS IN RUBBERLIKE NETWORK POLYMERS
Mitchel C. Shen (N. Am. Aviation Sci. Center) and Arthur V. Tobolsky Jun. 1965 19 p refs
(Contract Nonr-1858(07))
(ONR-TR-RLT-87; AD-465261)

Current kinetic theories of rubber elasticity are usually derived on the assumption that the strain-induced volume dilatation can be ignored. While satisfactory in explaining the general stress-strain behavior of elastomers, the constant volume constraint must be removed when the theory is invoked to describe quantities that directly involve volume dilatation itself. It is shown that such modification can be accomplished within the present theoretical framework. The resultant equation of state for rubber elasticity is $F = NkT(i_o^2/i_f^2)(\alpha - V/V_o\alpha^2)$. Based on the preceding equation, the anisotropy factor of Elliott and Lippman was shown to be unity, as long as the strain limit imposed by the Gaussian statistics is not exceeded. Expressions for the strain-induced volume dilatation and the internal energy component of elastic force are derived. No approximations are introduced. Calculated theoretical curves are shown to compare favorably with existing experimental evidence in the literature. Author

N65-32042*# Goodyear Aerospace Corp., Akron, Ohio.
PROGRAM FOR THE EVALUATION OF STRUCTURAL REINFORCED PLASTIC MATERIALS AT CRYOGENIC TEMPERATURES, PHASE II Annual and Fourth Quarterly Report, 29 Jun. 1964–30 Jun. 1965
L. W. Toth, T. J. Boller, A. H. Kariotis, F. D. Yoder, G. Nagy et al 30 Jun. 1965 152 p *Its* Progress Rept.-23
(Contract NAS8-11070)
(NASA-CR-64564; GER-11214-S/22) CFSTI: HC $5.00/MF $1.00 CSCL 11I

Work consisted of a statistical evaluation of testing techniques and data, a determination of the possible effects of environment, and the testing of structural plastic models. Previous test data was statistically evaluated to establish its reproducibility and general validity. Simple mathematical expressions were derived that best characterize the test data, and the closeness of the fit of the test data to these mathematical expressions indicated the validity of the test results. The need for additional test data or variations in test methods was indicated in a few instances, and additional testing was performed. A series of experiments were conducted to determine the effects of environmental parameters on physical properties. Panels of four materials were exposed to light and water exposure cycle prior to the testing of specimens in flexure and compression. Tests indicated no detrimental effects from this exposure. The previously developed data was validated through the testing of structural models. R.N.A.

N65-32063# Bureau of Mines, Albany, Oreg. Metallurgy Research Center.
DEVITRIFICATION OF VACUUM-MELTED GLASSES OF THE LITHIUM METASILICATE-SILICA COMPOSITIONAL SERIES
Jack I. Paige, Henry M. Harris, and Hal J. Kelly 1965 19 p refs
(BM-RI-6651)

The devitrification of lithium silicate glasses was studied to determine the effect of annealing temperature, composition, and additives on nucleation and crystallization. High-purity glasses, prepared from reagent-grade chemicals, had close to optical quality when prepared by a vacuum induction melting method developed during this research. The progress of devitrification was traced by differential thermal analysis and thermal expansion for those lithium metasilicate-silica compositions containing 80 to 90 percent silica. Microscopic studies of glasses partially devitrified at various temperatures and annealing times indicated that the primary initial mode of formation of individual crystals was from densely crystalline zones that filled in as crystallization advanced. Of the additives tested, calcium, potassium, and sodium helped promote devitrification with the least cracking or surface deformation. Tin oxide was most effective in reducing volume contraction during devitrification, but was not as effective in preventing cracking as calcium or potassium additions. Author

N65-32106# Akron Univ., Ohio. Inst. of Rubber Research.
LOW TEMPERATURE POLYMERIZATION STUDIES Progress Report, Apr. 1–Jun. 30, 1965
Maurice Morton 15 Jul. 1965 65 p refs
(Contract AF 04(611)-9694)
(PR-6; AD-618228)

Differential thermal analysis work was conducted using acrylonitrile. Exploratory polymerizations or attempted polymerizations of tetracyanoethylene, perfluorobutene-2, hexafluoropropylene, vinyl triethoxysilane, p-nitrostyrene, and benzaldehyde were also conducted. The polymerization of the fluoroethylenes included the polymerization of mono-, di- and trifluoroethylene. A literature survey was completed on the monomers having the function groups C = O, C ≡ N, and C ≡ C. Work continued on the radiation polymerization of trifluoroacetaldehyde. The very fast bulk reaction observed with this monomer at −78° C hinted at a possible ionic mechanism. To throw light on this, the effects of different solvents were examined. Results are presented on polymerizations in diethyl ether and in methylene chloride. R.N.A.

N65-32162*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
YIELD STRESS MASTER CURVES FOR VARIOUS POLYMERS BELOW THEIR GLASS TRANSITION TEMPERATURES
Jerome J. Lohr [1964] 31 p refs
(NASA-TM-X-54800) CFSTI: HC $2.00/MF $0.50 CSCL 11I

Yield stress master curves, similar in concept to the stress relaxation master curve, are presented for: poly(methyl methacrylate), polystyrene, polyvinyl chloride, and polyethylene terephthalate. Tensile yield stress was measured at strain rates varying from 0.003 in/in/min to 300 in/in/min and at temperatures varying from approximately 15° C above the glass transition temperature, T_g, to at least 100° C below T_g. The master curve for each material has a characteristic slope which leads, in each case, to a simple equation relating yield stress to strain rate and temperature, and is applicable for temperatures from T_g to approximately 100° C below T_g. The temperature-dependent shift factors, a_T, of each material were determined both for yield stress and stress relaxation over the temperature range. Comparison of these a_T curves shows that in both the ductile and brittle temperature ranges of each material, the shape of the yield stress and stress relaxation a_T curves are very similar; however, the absolute magnitude of the change with temperature can be substantially different. Presented are two possible explanations for this difference. S.C.W.

N65-32255*# General Electric Co., Philadelphia, Pa. Reentry Systems Dept.
ANALYTICAL COMPARISONS OF ABLATIVE NOZZLE MATERIALS Final Report, 20 Jun. 1963–20 Nov. 1964
1 Jul. 1965 385 p refs
(Contract NAS3-2566)
(NASA-CA-54257) CFSTI: HC $7.00/MF $2.00 CSCL 11I

A reaction kinetics ablation program was developed to analytically predict the ablation performance of rocket nozzle heat protection materials. The program was written in FORTRAN IV and made compatible with the NASA Lewis computation facilities. The program can be used to predict the thermal degradation of a wide variety of materials exposed to an external source of heat. The program includes the effects of mass addition on heat transfer, the calculation of internal gas pressure and internal material stresses and a number of other options for surface or char removal. The comparative performance of phenolic nylon, phenolic graphite and phenolic refrasil as rocket nozzle heat protection materials was investigated. The results are reported for these materials exposed to the heating environment produced by the propellant combinations of hydrogen/oxygen and N_2O_4/UDMH-N_2H_4 (50-50). Author

N65-32288# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF HEAT DISINTEGRATION ON THE THERMOPHYSICAL PROPERTIES OF MONOISOPROPYLDIPHENYL
D. S. Rasskazov, Yu. M. Babikov, and K. Khamann 14 Jul. 1965 13 p refs Transl. into ENGLISH from Teploenerg. (Moscow), no. 9, 1964 p 71–73
(FTD-TT-65-344/1+2+4; AD-618634)

The effect of a high boiling radical, monoisopropyldiphenyl, on the viscosity and density of its partially disintegrated liquid; and the heat resistance of the radical were studied. The layout showing the principles of the heat disintegration experimental unit is presented. During the disintegration process, samples of liquid were withdrawn, and analyzed by vacuum distillation and a cryoscopic method for determining the amount of high boiling radical in the sample. Experimental data for the disintegration of pure radical liquid at temperatures of 370° C, 380° C, and 400° C are tabulated, and data for partially disintegrated radical liquid are tabulated. Results indicate that the relative viscosity is a function of the temperature and percentage content of high boiling radical. As the content of high-boiling radical increases, viscosity increases with decreasing temperature. L.S.

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N65-31289 Joint Publications Research Service, Washington, D.C.
CONJUGATION CONDITIONS FOR THE TRANSITION PROBABILITY DENSITY OF A MARKOV PROCESS WITH DISCONTINUOUS COEFFICIENTS
M. L. Tay *In its* Izv. VUZov: Radiofiz., Vol. VIII, No. 2, 1965 10 Aug. 1965 p 154–163 refs (See N65-31275 20-23)
CFSTI: $6.00

From Smolukhovskiy's equation the author finds the conditions satisfied by the transition probability density function of a Markov process, homogeneous with respect to time, having discontinuous coefficients of drift and diffusion. Comparison of the theoretical and experimental data shows that using these conjugation conditions gives a correct result. Author

N65-31305 Joint Publications Research Service, Washington, D. C.
THEORY OF THE LAPLACE TRANSFORM
K. G. Valeyev *In its* Izv. VUZov: Radiofiz., Vol. VIII, No. 2, 1965 10 Aug. 1965 p 282–284 refs (See N65-31275 20-23)
CFSTI: $6.00

A solution is given for the determination of the transform of a function with periodic delay. It is shown that a transcendental equation for determining the poles of Laplace transform can be constructed; and the characteristic roots with the greatest real portion can be determined for the equation. M.W.R.

N65-31502# Utah Univ., Salt Lake City. Dept. of Mathematics.
THE BOUNDEDNESS, STABILITY AND REDUCIBILITY OF LINEAR HOMOGENEOUS SYSTEMS
Max Robert Lund (M.S. Thesis) Jun. 1965 48 p refs
(AD-617306)

The linear homogeneous equation $X' = A(t)X$ is treated where A (t) is an n–by–n matrix of continuous (complex valued) functions of a real variable t. The question of boundedness of solutions or, equivalently, the uniform stability is considered. Criteria for restrictive stability, and the behavior of the matrix integral for large t and certain comparison theorems are investigated. Reducibility is defined, and two necessary and sufficient conditions for reduction are given. The periodicity of matrix integrals, and the stability of arbitrary periodic systems are also considered. C.T.C.

N65-31580# Aberdeen Proving Ground, Md. Ballistic Research Labs.
A METHOD FOR INVERTING LARGE MATRICES OF SPECIAL FORM
Palmer R. Schlegel Dec. 1964 24 p refs
(BRL-MR-1624; AD-460305)

An algorithm for inverting large matrices, U, is constructed, where I, (identity matrix), O (null matrix), and A are matrices of the order m × m. The advantage of this method is that each row of the partitioned inverse matrix can be constructed by multiplying the previous row by some matrix. The entire procedure involves algebraic operations and the inversion of matrices of the order m × m. This is a convenient procedure to be used on a computer for inverting special matrices of large order. R.W.H.

N65-31602# Texas A&M Univ., College Station. Inst. of Statistics.
UNEQUAL PROBABILITY SAMPLING THEORY AND THE TIME SERIES ASPECTS OF PANEL SURVEYS Final Report
H. O. Hartley [1965] 11 p refs
(Grant DA-31-124-ARO(D)-127)
(AROD-4177-1; AD-464230)

The following problem in unequal probability sampling was studied in detail: each unit in a finite population has a known measure of size and an undetermined characteristic value; the sum of all the characteristic values is to be estimated by sampling without replacement, where the probability that a particular unit will be sampled is proportional to its size value. A brief literature review on this subject is presented. The use of systematic sampling and the derivation of exact variance formulas for the systematic draw from a randomized sequence of units were investigated, and results to be published at a later date are discussed informally. Work in progress on a study of sampling of populations on repeated occasions is discussed briefly. J.M.D.

N65-31603# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
AN APPROACH TO NONLINEAR NETWORKS
Bernard Friedman (Calif. Univ., Berkeley) Sep. 1963 50 p refs *Its* Mathematical Note No. 325
(DI-82-0307; AD-450113)

A very elementary and intuitive approach is used in discussing several mathematical topics which seem relevant to the treatment of nonlinear networks. Linear spaces, bivectors, determinants, and derivations are considered in exterior algebra. Chains, boundaries, current chains, co-chains, voltage co-chains, Tellegen's theorem, and the integral theorem are used in presenting the topology of networks. A discussion of nonlinear networks includes such topics as relations between currents and voltages; equilibrium equations; mixed potential; and the mixed potential for a complete set. An example is given of the calculation of a mixed potential. Finally, three stability theorems are presented. C.T.C.

N65-31638# Rocketdyne, Canoga Park, Calif.
DESIGN, TESTING AND ESTIMATION IN COMPLEX EXPERIMENTATION. II: RELIABILITY GROWTH PROCESSES: ESTIMATION THEORY AND DECISION—THEORETIC FORMULATIONS Final Report
Bernard Sherman and Mitchell O. Locks Wright-Patterson AFB, Ohio, ARL, Jun. 1965. 76 p refs
(Contract AF 33(616)-7372)
(R-6078-2; ARL-65-116, Pt. II; AD-618516)

Properties of maximum-likelihood estimators of parameters of reliability growth processes are investigated. It is shown that the maximum-likelihood estimator for a simple process involving a single failure mode is not consistent. For a modification of this process, a proof of consistency is sketched. Decision-theoretic studies of reliability growth have included investigations of the minimum-loss redesign policy, single-stage improvement models, and optimum effort for reliability growth. Author

N65-31639# Rocketdyne, Canoga Park, Calif.
DESIGN, TESTING AND ESTIMATION IN COMPLEX EXPERIMENTATION. III: THE DESIGN AND ANALYSIS OF MULTIVARIATE SENSITIVITY EXPERIMENTS
Madeline J. Alexander Wright-Patterson AFB, Ohio, Aerospace Res. Labs., Jun. 1965 87 p ref
(Contract AF 33(616)-7372)
(ARL-65-116, Pt. III; AD-618517)

This report contains research results obtained on the design and analysis of quantal-response experiments involving one or more stimuli. In particular a univariate nonparametric design for estimating the stimulus level corresponding to a given response-fraction, α, is developed. Special attention is given to extreme values of α. In addition, an algorithm for determining maximum-likelihood estimates of partially ordered probabilities and its application to various aspects of multivariate sensitivity experiments are described. A method for handling such experiments when the stimuli do not "interact" is discussed and a nonparametric statistical design with point estimates is given. Finally, response models are developed for various conditional distribution requirements on the stimuli. For a large class of these response surfaces the equal-probability response contours are shown to be hyperbolas. Author

N65-31785# United Kingdom Atomic Energy Authority, Harwell (England). Metallurgy Div.
TABLES OF SIN X ÷ X TO SIX DECIMAL POINTS
D. G. Martin May 1965 118 p refs
(AERE-R-4934) HMSO: 16s

Tables of the function Sin x/x to six decimal places are given for values of x between (1) 0 and 50 radians in intervals of a thousandth of a radian, and (2) 50 and 100 radians in intervals of a hundredth of a radian. In both tables first differences are also given. Author

N65-31786# United Kingdom Atomic Energy Authority, Harwell (England). Metallurgy Div.
TABLES OF SIN^2 X ÷ X^2 TO SIX DECIMAL POINTS
D. G. Martin May 1965 73 p refs
(AERE-R-4935) HMSO: 10s

Tables of the function Sin^2x/x^2 to six decimal places are given for values of x between (1) 0 and 25 radians in intervals of a thousandth of a radian, and (2) 25 and 100 radians in intervals of a hundredth of a radian. In both tables first differences are also given. Author

N65-31816# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ON THE GIBBS' PHENOMENON IN THE APPROXIMATION OF FUNCTIONS BY ALGEBRAIC POLYNOMIALS
V. B. Grishin [1964] 5 p refs Transl. into ENGLISH from Vopr. Mat. Fiz. i Teoriifunkisii (Kiev), no. 1, 1964 p 18–24

It is proven that in approximating nonperiodic functions of bounded variation by partial sums of a series, the Gibbs phenomenon occurs at each isolated point of discontinuity. A series which is the analog of the Fourier series for a periodic function is used. C.T.C.

N65-31845# Wisconsin Univ., Madison. Mathematics Research Center.
A NOTE ON LIMIT THEOREMS FOR MARKOV BRANCHING PROCESSES
Howard Conner Feb. 1965 15 p refs
(Contract DA-11-022-ORD-2059)
(MRC-TSR-545; AD-614937)

This paper shows how the fundamental limit theorems for continuous parameter Markov branching processes can be derived using the corresponding limit theorems for Galton-Watson processes. Each limit theorem is considered in a general context which connects the limiting behavior of an appropriate functiin $\pi(t)$ as $t \to \infty$ with that of the sequences $\pi(n\Delta)$, $\Delta > 0$, as $n \to \infty$. Author

N65-31846# Wisconsin Univ., Madison. Mathematics Research Center.
NEW INTEGRAL REPRESENTATIONS OF THE MODIFIED BESSEL FUNCTION OF THE SECOND KIND
F. M. Ragab Mar. 1965 19 p refs
(Contract DA-11-022-ORD-2059)
(MRC-TSR-544; AD-614934)

The main theorem to be proved is

$$\int_0^\infty t^{\nu-1} E(p:\alpha_r:q:\rho_s:t)\, E(q:\rho_s+\nu:p,\alpha_r+\nu:\frac{4}{z^2}t)dt = 2^{\nu+1} z^{-\nu} K_\nu(z),$$

where $K_\nu(z)$ is the modified Bessel function of the second kind and the parameters are such that the integral is convergent. By specializing the values of the parameters α's and ρ's in the above integral, many new integral representations of $K_\nu(z)$ are listed. Author

N65-31880# California Univ., Berkeley. Operations Research Center.
BOUNDS FOR LATTICE DISTRIBUTIONS HAVING MONOTONE HAZARD RATE WITH APPLICATIONS
Gamanlal P. Shah Jun. 1965 37 p refs
(Contract Nonr-3656(18))
(ORC-65-12; AD-618112)

Using methods which have been employed for obtaining bounds on continuous failure distributions, bounds on lattice distributions are derived under the increasing (decreasing) failure rate assumptions. The discrete bounds are convenient in a number of applications such as life table analysis and reliability theory. Author

N65-31889# Rice Univ., Houston, Tex.
GENERALIZED APPROACH TO THE CALCULUS OF VARIATIONS IN TWO INDEPENDENT VARIABLES
Angelo Miele 1965 38 p refs Submitted for Publication *Its* Aero-Astronautics Rept. No. 2
(Grant AF-AFOSR-828-65)
(AD-468759)

Previously, the minimization of a functional involving two independent variables and one dependent variable was considered and the main necessary conditions for the extremum were derived. This analysis is extended to functionals involving several dependent variables. The case of unconstrained variables is analyzed in connection with the minimization of the sum of a surface integral and a line integral evaluated along the boundary of the surface. For this problem the Euler equations, the transversality condition, the corner condition, the Legendre condition, and the Weierstrass condition are derived. Also, some mathematical artifices are discussed for engineering problems not covered by the formulations of Bolza, Lagrange, and Mayer such as problems involving higher derivatives, problems not involving derivatives, and problems involving inequality constraints. E.E.B.

N65-31963# Wisconsin Univ., Madison. Mathematics Research Center.
NEW INTEGRAL REPRESENTATIONS FOR THE BESSEL FUNCTION $J_{nu}(x)$
F. M. Ragab Feb. 1965 12 p refs
(Contract DA-11-022-ORD-2059)
(MRC-552; AD-614931)

The following formula is established

$$J_\rho(x) = \frac{x^{\rho+2}}{2^{2\rho+4}} \int_0^\infty t^{\frac{1}{2}} E(p:\alpha_r:q:\rho_s:t) E(q:\rho_s+\tfrac{1}{2}p+2:\alpha_r+\tfrac{1}{2}\tfrac{\rho}{2}+1,\tfrac{\rho}{2}+\tfrac{3}{2},\tfrac{256}{x^4}t)dt$$

where $J_\rho(x)$ is the Bessel function and the parameters in Mac Roberts' E-functions are such that the integral is convergent. By specializing the values and number of the parameters, new integral representations for $J_\rho(x)$ are obtained. Author

N65-31995# Rocketdyne, Canoga Park, Calif.
DESIGN, TESTING AND ESTIMATION IN COMPLEX EXPERIMENTATION. I: EXPANSIBLE AND CONTRACTIBLE FACTORIAL DESIGNS AND THE APPLICATION OF LINEAR PROGRAMMING TO COMBINATORIAL PROBLEMS Final Report, Period Ending Feb. 1965
Steve R. Webb Wright-Patterson AFB, Ohio, ARL, Jun. 1965 166 p
(Contract AF 33(616)-7372)
(R-6078-1; ARL-65-116, Pt. 1; AD-618515)

This report describes results of research on factorial designs. These include (1) characterizations of orthogonal and two classes of non-orthogonal designs as solutions to linear constraints, (2) optimality properties of orthogonal designs, (3) development of a general class of non-orthogonal sequential factorial designs, (4) results on certain families of 2^n designs, and (5) description of a special-purpose linear programing computer routine for combinatorial problems in experimental design. Author

N65-32036*# Kent State Univ., Ohio. Dept. of Mathematics.
SOME TOPOLOGICAL PROPERTIES OF HALFGROUPOIDS Technical Report No. 8
Sigride E. Ohm (M.S. Thesis) Aug. 1965 34 p refs
(Grant NsG-568)
(NASA-CR-64543) CFSTI: HC $2.00/MF $0.50 CSCL 12A

The relationship between a particular topological space and a general algebraic structure is investigated. The approach used is that of interpreting certain topological properties in terms of the structure of the halfgroupoid. The general notation used throughout the discussion is explained and definitions of some basic algebraic concepts are presented. The left ideal topology on an arbitrary halfgroupoid is established and such things as continuity of operation in the halfgroupoid, the topological separation axioms, and toplogical connectedness are examined. The analysis of algebra and topology is extended to include the theory of graphs. Because a halfgroupoid may be thought of as a set on which a ternary relation is defined, while a directed graph is a set on which a binary relation is defined, these two mathematical systems are somewhat related. A topological correspondence can be formulated between them by defining a mapping between halfgroupoids and digraphs under which the left ideal topology proves to be identical to the digraph topology. Thus, a three-way connection between algebra, topology, and graph theory is created. R.N.A.

N65-32057# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.

PEAKEDNESS OF DISTRIBUTIONS OF CONVEX COMBINATIONS

Frank Proschan Nov. 1964 15 p refs Work Completed at California Univ. *Its* Math. Note No. 370

(Contract Nonr-3656(18))

(DI-82-0385; ORC-64-26(RR); AD-614788)

This paper presents simple sufficient conditions under which the distribution of the sample average shows increasing peakedness with increasing sample size. The results are actually more general, permitting a comparison of the peakedness of distributions of various convex combinations of sample observations. Author

N65-32058# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.

EXPONENTIAL LIFE TEST PROCEDURES WHEN THE DISTRIBUTION HAS MONOTONE FAILURE RATE

Richard E. Barlow and Frank Proschan Feb. 1965 40 p refs Work Completed at California Univ. *Its* Math. Note No. 396

(Contract Nonr-3656(18))

(DI-82-0415; ORC-64-29; AD-614608)

A number of estimates and tests for mean life and other parameters derived under the exponential distribution assumption are studied under the alternative condition that the distribution has increasing (decreasing) failure rate. The estimates considered are, for the most part, based on censored and truncated samples. It is shown that these estimates generally favor the producer (consumer) in the IFR (DFR) case. Properties of order statistics and their spacings from distributions with increasing (decreasing) failure rate are presented. Author

N65-32131# System Development Corp., Santa Monica, Calif.

APPLICATION GENERALITY OF SOME RESULTS FOR ANALYSIS OF VARIANCE

John E. Walsh 7 Jul. 1965 15 p refs

(SP-2140; AD-617770)

Attention is called to a very general unconditional model for representing the observed outcomes resulting from use of some experimental designs in analysis of variance. Included as special cases are factorial, randomized block, and split plot designs. In particular, the outcomes can be correlated almost arbitrarily and can have appreciably different variances. In spite of this generality, the sum of squares for error, the sum of squares for treatments, and estimates of contrasts (comparisons) in treatment effects possess the properties that would occur if the observations were independent and the random error terms had the same distribution. These estimates and tests are known to be applicable for a broad class of situations when the error terms constitute a random sample. Author

N65-32153*# Montana State Coll., Bozeman.

A NONPARAMETRIC ESTIMATE OF A MULTIVARIATE DENSITY FUNCTION

D. O. Loftsgaarden and C. P. Quesenberry [1964] 10 p refs Submitted for Publication

(Grant NsG-562)

(NASA-CR-59360) CFSTI: HC $1.00/MF $0.50 CSCL 12A

Presented is a nonparametric estimate of the probability density function

$$f(x_1,\ldots,x_p) = \frac{\partial^p F(x_1,\ldots,x_p)}{\partial x_1,\ldots,\partial x_p}$$

at a point $z = (z_1,\ldots,z_p)$ where f is positive and continuous. To overcome the problem of choosing a neighborhood about the point z where the density is being estimated, a random neighborhood which is a function of n and of the observations $x_1,\ldots,x_n$ was used. An estimate based on this random neighborhood is proposed and shown to be consistent. A special case is considered which illustrates how estimates can be obtained in certain cases other than those considered in the present analysis. S.C.W.

N65-32182*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

HIGHER ORDER APPROXIMATIONS OF RUNGE-KUTTA TYPE

E. Baylis Shanks Washington, NASA, Sep. 1965 25 p ref (NASA-TN-D-2920) CFSTI: HC $2.00/MF $0.50 CSCL 12A

The fourth-order formula of Runge-Kutta has been used extensively to obtain approximate solutions of differential equations of first, second, and higher orders. This formula requires only four evaluations of the function involved in the differential equation while the fifth-order formula of Kutta-Nystrom requires six evaluations of the function. The sixth-order formula of Huta is not known as well, and has the disadvantage of requiring eight evaluations of the function. No formulas of higher order except those developed in this investigation seem to exist in the literature. These formulas are "self-starting" and therefore extremely useful in combination with efficient "continuing" procedures. Formulas of higher order, including the seventh and eighth orders, are developed in this paper. Moreover, more efficient formulas requiring fewer evaluations are developed for orders five and six. All possible formulas are displayed for those orders below five. Author

N65-32194*# Southwest Center For Advanced Studies, Dallas, Tex.

CALCULATION OF SUBDOMINANT SOLUTIONS OF LINEAR DIFFERENTIAL EQUATIONS

J. E. Midgley May 1965 21 p Submitted for Publication

(Grant NsG-269-62)

(NASA-CR-64531; AD-616642) CFSTI: HC $1.00/MF $0.50 CSCL 12A

A method for numerical solution of N^{th} order systems of differential equations is developed which is useful where some of the solutions grow rapidly in the interval of integration. This kind of inordinate growth—or dominance—occurs when the inclusion of a physical effect in the equations such as viscosity, thermal conductivity, or resistivity, has only a small effect on the solution but raises the order of the equations. The technique is iterative, and consists of first isolating these dominating solutions one at a time in order of their dominance, and expressing the general solution as a product of the dominant solution and a new function. Treating the equation for this new function, which is one order lower, in the same way as the original equation eliminates the next dominant solution, and the process is repeated until the problem is solved. J.M.D.

N65-32234# Stanford Univ., Calif. Inst. for Mathematical Studies in the Social Sciences.

AN INPUT-OUTPUT SYSTEM INVOLVING NON-TRANSFERABLE GOODS

Michio Morishima and Yasuo Murata 30 Jun. 1965 21 p refs

(Contract Nonr-225(50))

(TR-134; AD-618404)

The most important characteristics of capital goods are durability and nontransferability. When time goes on, the number of periods during which a capital good can survive decreases, and it becomes less productive. The other problem relates

to the fact that no capital good can be transferred to another industry once it has been installed in some industry. This paper re-examines the dynamic input-output model of Leontief's type from this point of view, and shows how it has to be altered, on the assumptions that there is no technical change and that prices are so flexible as to establish the long-run equilibrium price conditions instantaneously. We begin by proving the dynamic substitution theorem, assuming the existence of differentiable general neo-classical production functions, taking vintages of capital goods into explicit account. Then the existence of the golden equilibrium of the model is discussed. Author

N65-32250*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NUMERICAL ANALYSIS OF LAPLACE'S EQUATION WITH NONLINEAR BOUNDARY CONDITIONS
Edward Clarence Bittner (Ph.D. Thesis, Case Inst. of Tech.) 1965 82 p refs
(NASA-TM-X-52128) CFSTI: HC $3.00/MF $0.75 CSCL 12A

Existence of solutions of two-dimensional boundary-value problems of the type

$$\nabla^2 u = 0 \quad \text{in R},$$
$$u(P) = 0 \quad \text{on } \Gamma_1,$$
$$\partial u/\partial n = \gamma(P,u) \quad \text{on } \Gamma_2,$$

is discussed under conditions subsequently strengthened for uniqueness. In general, solutions are shown to lie between a maximum possible and a minimum possible, which extremes are obtainable as limits of sequences of solutions of certain linear problems. Under convexity assumptions on γ, the unique solution is shown to be obtainable as a maximum over solutions of an entire class of linear problems, and is also obtainable by Newton's method. Finite difference approximations are shown by a Gerschgorin-type analysis to converge to solutions of the above, at essentially the rate $O(h^{1/3})$ as $h \to 0$, where h is the maximum mesh width. The order of convergence is tied to the smoothness of γ, Γ_1, and Γ_2, and more general results are actually obtained. Author

N65-32287# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONSTRUCTION OF A SET OF SYSTEMS OF DIFFERENTIAL EQUATIONS DESCRIBING STABLE MOTION BY A GIVEN PROCEDURE
I. A. Mokhametzyanov 12 Jul. 1965 8 p refs Transl. into ENGLISH from Tr. Univ. Druzhby Narodov Im. Patrisa Lumumby (Russia), v. 1, no. 1, 1963 p 52–55
(FTD-TT-65-341/1+4; AD-618629)

A system of differential equations is devised which is used to describe stable motion in relation to particular equations for trajectory and changes in coordinates. J.M.D.

N65-32306# North Carolina State Coll., Raleigh.
PROOF OF MOSER'S INVARIANT CURVE THEOREM IN THE ANALYTIC CASE Technical Report No. 1
Thomas Gilmer Proctor Jan. 1965 24 p refs
(Grant DA-ARO(D)-31-124-G565)
(PRS-26; AROD-4105-12; AD-616278)

In this report a theorem is proved establishing the existence of curves with analytic representation which are invariant under a certain analytic area preserving mapping. The mapping is a perturbation of a rotation or twist mapping and arises naturally in some undamped physical motions. This theorem modifies an invariant curve theorem proved by J. Moser to guarantee that there are "analytic" curves invariant under the mapping and is an application of a technique for overcoming small divisors which was introduced by Kolmogorov in the study of perturbations of integrable Hamiltonian systems. Author

N65-32342# Bureau of Mines, Denver, Colo. Denver Mining Research Center.
SOME GENERALIZED PROBABILITY DISTRIBUTIONS WITH SPECIAL REFERENCE TO THE MINERAL INDUSTRIES. 2: SAMPLING TO γ AMOUNT OF ITEMS PER SAMPLE
Robert M. Becker 1964 104 p refs
(BM-RI-6552)

This report presents the mathematical development in extending the theory of sample reliability from a sample consisting of a fixed number of items to a sample consisting of a fixed amount of items. Examples of a fixed amount of items per sample are samples consisting of a fixed weight or a fixed volume of unequal size particles. The probability distribution functions (those here called the compound binomial and compound multinomial functions) are developed from fundamentals. Their distributions are generalized to include some measured characteristic of the items. Infinite population moments are derived from moment-generating functions, while finite population moments are developed from corresponding infinite population moments using the finite probability operator defined in part 1 of this series. Author

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N65-31350# Thornwaite (C.W.) Associates, Centerton, N. J. Lab. of Climatology.
RECENT DEVELOPMENTS IN METEOROLOGICAL SENSORS AND MEASURING TECHNIQUES TO 150,000 FEET. PART I: ANALYSIS Final Report
John R. Mather, ed. 30 Apr. 1965 110 p refs
(Contract DA-28-043-AMC-00001(E))
(AD-616355)

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9. RADIATION SENSORS F. L. Mowry p 87–90 refs (See N65-31359 20-20)

10. REFERENCES p 91–102

N65-31351 London Univ. (England). Dept. of Geography.
METEOROLOGICAL CONDITIONS AND MEASUREMENTS IN THE STRATOSPHERE
F. Kenneth Hare *In* Thornthwaite (C. W.) Associates Recent Develop. in Meteorol. Sensors and Measuring Tech. to 150,000 Feet. Pt. I: Analysis 30 Apr. 1965 p 1–8 (See N65-31350 20-20)

Presented is a review of the effectiveness of available instrumentation for measuring temperature, wind, humidity, pressure, density, radiation, and ozone of the stratosphere. Considered are present data concerning variations of these parameters in time and space, and of the capacity of available instrumentation to cope with the known variabilities. It is concluded that present methods for observing standard parameters in the layer between 15 to 50 km are unsatisfactory and that developments over the past two years have only marginally closed the gap between what is needed and what is available. Among the recommendations proposed are included: (1) the development of accurate height-determining methods for all sensors, to eliminate dependence on the hydrostatic equation to maximum possible extent; (2) the further development and deployment of ozonesonde systems to round out the promising beginning now being made towards an ozone network; and (3) the elimination of radiation errors from operation radiosonde equipment. S.C.W.

N65-31352 Thornthwaite (C. W.) Associates, Centerton, N. J. Lab. of Climatology.
VEHICLES AND SOUNDING SYSTEMS
John R. Mather *In its* Recent Develop. in Meteorol. Sensors and Measuring Tech. to 150,000 Feet. Pt. I: Analysis 30 Apr. 1965 p 9–19 (See N65-31350 20-20)

Presented is a discussion of different types of sounding systems for obtaining meteorological measurements at heights above the ground, and recent developments in sounding systems which focuses on the status of balloon and rocket vehicles. Considered are passive and active systems and the techniques used in each of these sounding systems as: passive observation systems using ground-based sensors, balloon-borne sounding systems, rocket-borne sounding systems, rocket-probe sounding systems, and lower-level sounding systems including airplane sounding systems and dropsondes. Reviewed are significant developments in the area of balloon and rocket vehicles, and air-launched rocket systems. Also included is a synopsis of future developments in rocket sounding systems. S.C.W.

N65-31353 Thornthwaite (C. W.) Associates, Centerton, N. J. Lab. of Climatology.
TEMPERATURE SENSORS
Richard T. Field *In its* Recent Develop. in Meteorol. Sensors and Measuring Tech. to 150,000 Feet. Pt. I: Analysis 30 Apr. 1965 p 20–30 (See N65-31350 30-20)

An analysis of immersion sensors and non-immersion techniques for measuring atmospheric temperature is presented. Discussed are the advantages and inherent problems associated with the use of rod and bead thermistors, sonic thermometers, the rocket grenade technique, and radiation thermometers. Also discussed are future trends in the development of sensors for use at altitudes above 55 km. S.C.W.

N65-31354 Thornthwaite (C. W.) Associates, Centerton, N. J. Lab. of Climatology.
WIND SPEED AND DIRECTION SENSORS
William J. Superior *In its* Recent Develop. in Meteorol. Sensors and Measuring Tech. to 150,000 Feet. Pt. I: Analysis 30 Apr. 1965 p 31–46 (See N65-31350 20-20)

Discussed are sensors and techniques for measuring upper air atmospheric properties as wind speed and direction. Analyzed are the advantages and inherent problems associated with the use of rawinsonde sensors; chaff, parachute, and balloonsphere sensors; and techniques which focus on the use of ozonosphere as a target for upper-air wind measurements. Proposed are methods for improving current meteorological rocket wind-sensing systems, among which are cited: (1) the standardization of meteorological rocket wind finding systems; (2) the development of a new type of inexpensive meteorological rocket with a frangible case and engine, which would reduce restrictions on observation sites and allow improved spacing of stations; and (3) the development of a single vehicle system which would give information from ground up to at least 60 km within one hour's time. S.C.W.

N65-31355 Thornthwaite (C. W.) Associates, Centerton, N. J. Lab. of Climatology.
HUMIDITY SENSORS
Richard T. Field *In its* Recent Develop. in Meteorol. Sensors and Measuring Tech. to 150,000 Feet. Pt. I: Analysis 30 Apr. 1965 p 47–56 refs (See N65-31350 20-20)

The current development status of sensor techniques used in stratospheric moisture measurements is discussed. Analyzed are: electric hygrometers, barium fluoride sensors, dew-point techniques, aluminum oxide sensors, capacitive hygrometers, and optical methods. Future developments designed to extend routine humidity measurements above the present 7 km ceiling imposed by low temperature on the current radiosonde electric hygrometers, are also discussed. S.C.W.

N65-31356 Thornthwaite (C. W.) Associates, Centerton, N. J. Lab. of Climatology.
OZONE SENSORS
John R. Mather *In its* Recent Develop. in Meteorol. Sensors and Measuring Tech. to 150,000 Feet. Pt. I: Analysis 30 Apr. 1965 p 57–68 refs (See N65-31350 20-20)

Current sensor techniques for determining ozone concentration in the atmosphere are discussed. Considered are ozone sensors which fall into the following two general categories: (a) chemical methods, including both wet- and dry-process methods; and (b) optical or spectrometric methods, including both direct and indirect methods. Analyzed are the advantages and inherent problems associated with the use of the following chemical methods: the Regener wet-chemical method, the Brewer-Mast development electrochemical method, the carbon-iodine method, the Regener chemiluminescent method, the heat of decomposition of ozone method, and the radioactive quinol-Kr^{85} clathrate method. Among the optical or spectrometric methods discussed are included: the Dobson-Harrison indirect optical method, the Umkehr method, the infrared absorption method (in 9.6 micron band), the starlight ultraviolet method, and the Paetzold ultraviolet spectograph method. Included is a discussion of future trends in the development of new techniques. S.C.W.

N65-31357 Thornthwaite (C. W.) Associates, Centerton, N. J. Lab. of Climatology.
PRESSURE SENSORS

William J. Superior *In its* Recent Develop. in Meteorol. Sensors and Measuring Tech. to 150,000 Feet. Pt. I: Analysis 30 Apr. 1965 p 69–76 (See N65-31350 20-20)

Discussed are several techniques and sensors used for measuring pressure in the atmosphere at high altitudes. Analyzed are the advantages and inherent problems associated with the use of diaphragm gauges, Bourdon tube gauges, hypsometers, ionization gauges, thermal conductivity gauges, and pitot-static tubes. It is concluded that further developments which improve the accuracy of presently available standard sensors are useless unless the effect of the vehicle on the pressure reading can be eliminated. S.C.W.

N65-31358 Thornthwaite (C. W.) Associates, Centerton, N. J. Lab. of Climatology.

DENSITY SENSORS

Fred L. Mowry *In its* Recent Develop. in Meteorol. Sensors and Measuring Tech. to 150,000 Feet. Pt. I: Analysis 30 Apr. 1965 p 77–86 (See N65-31350 20-20)

An analysis of the current status of density measuring sensors and techniques is presented. Discussed are methods used to calculate density from pressure and temperature profile measurements; techniques used in measuring the drag on falling spheres; techniques using pressure-density gauges; and remote-sensing techniques. Trends in the future development of density measurement systems are also discussed. S.C.W.

N65-31359 Thornthwaite (C. W.) Associates, Centerton, N. J. Lab. of Climatology.

RADIATION SENSORS

Fred L. Mowry *In its* Recent Develop. in Meteorol. Sensors and Measuring Tech. to 150,000 feet. Pt. I: Analysis 30 Apr. 1965 p 87–102 refs (See N65-31350 20-20)

Current techniques and sensors used in radiation profile measurements are discussed. Analyzed are the advantages and inherent problems associated with using pyranometers, net radiometers, black ball radiometers, and spectroscopes. Also considered are trends in the future developement of radiative techniques and instrumentation. S.C.W.

N65-31369# Chicago Univ., Ill. Dept. of the Geophysical Sciences.

MESOMETEOROLOGICAL FIELD STUDIES Final Report, 1960–1965

Feb. 1965 212 p refs

(Contract AF 19(604)-7259)

(AFCRL-65-220; AD-616910)

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6. THE LAND AND SEA BREEZE: AN ANNOTATED BIBLIOGRAPHY G. L. Baralt and R. A. Brown 61 p refs (See N65-31374 20-20)

N65-31370 Chicago Univ., Ill. Dept. of the Geophysical Sciences.

PRECIPITATION IN THE 1960 FLAGSTAFF MESOMETEOROLOGICAL NETWORK

Kenneth A. Styber *In its* Mesometeorological Field Studies Feb. 1965 20 p refs (See N65-31369 20-20)

Precipitation measurements were made using 165 small, transparent plastic cups and 165 aluminum-foil hail indicators. Instrument spacing of from one to four miles along servicing routes in the network area proved satisfactory. Both the rain gage and hail indicator provided reliable measurements. The small-cup rain gages were somewhat more effective in collecting rain up to 0.5 or 0.6 inch than standard gages. Personnel attempted to service the network each day prior to the afternoon convective activity; however, this was not always possible. For those measurements including rainfall of more than one day, separation into single-day amounts was effected. Analysis showed that the isohyets of maximum rainfall were elongated in the direction of the 700- to 500-mb winds. Practically all of the heavy rain storms were accompanied by hail. At least two of the hail areas were observed to be of an elliptical configuration, and were covered by locally heavy fogs. Coincidence of the axes of maximum daily precipitation and the axes of maximum total precipitation lead one to suspect the existence of preferred storm tracks. Author

N65-31371 Chicago Univ., Ill. Dept. of the Geophysical Sciences.

ON THE DETERMINATION OF THE EXCHANGE COEFFICIENTS IN CONVECTIVE CLOUDS

Rodger A. Brown *In its* Mesometeorological Field Studies Feb. 1965 8 p refs (See N65-31369 20-20)

The conventional micrometeorological equations for the evaluation of the exchange coefficients near the ground are not adequate when one attempts to apply them to a convective cloud. Therefore a set of equations is proposed which is based only on the wind field; these expressions are especially useful in determining the exchange coefficients in numerical simulations. Using a simplified cloud model, the orders of magnitude of the eddy viscosity coefficient for vertical motion in cumulus humilis, cumulus congestus, and cumulonimbus are found to be 10^2, 10^3, and 10^4 m^2 sec^{-1}, respectively. Author

N65-31372 Chicago Univ., Ill. Dept. of the Geophysical Sciences.

A STUDY OF FACTORS CONTRIBUTING TO DISSIPATION OF ENERGY IN A DEVELOPING CUMULONIMBUS

Rodger A. Brown and Tetsuya Fujita *In its* Mesometeorological Field Studies Feb. 1965 69 p refs (See N65-31369 20-20)

This study is concerned with an orographic cumulonimbus that developed near Flagstaff, Arizona on 19 July 1960. The growth of small cumuli into the cumulonimbus and the expansion of the latter's top were investigated using stereo-pair photographs. The photogrammetric analysis revealed that the growth of the cumulus congestus stage was characterized by a series of

pulsations, each attaining greater heights than the previous one. The analysis of the anvil top revealed that it was rotating cyclonically as it expanded—an indication that the entire thunderstorm was rotating in the same sense, with vorticity values of up to 10^{-2} sec^{-1} or greater. At the time that the cumulonimbus was developing an anvil, aircraft temperature measurements were made at 11.3 km in the region surrounding both this storm and one that had developed about half an hour earlier. Equations are developed, using the entrainment technique, for determining temperature, liquid-water content, kinetic energy, vertical and radical components of velocity, and hydrostatic and non-hydrostatic parts of the pressure. Author

N65-31373 Chicago Univ., Ill. Dept. of the Geophysical Sciences.
A STUDY OF CUMULUS CLOUDS OVER THE FLAGSTAFF RESEARCH NETWORK WITH THE USE OF U-2 PHOTOGRAPHS
Dorothy L. Bradbury and Tetsuya Fujita *In its* Mesometeorological Field Studies Feb. 1965 26 p refs (See N65-31369 20-20)

Using cloud photographs taken by a U-2 aircraft equipped with a 180-deg panoramic camera, a technique of rectification is described. Mosaics of 13 passes over the San Francisco Mountains were made with the rectified cloud photographs. Computations of cloud movement and change in the horizontal area of cloud were made by use of cloud and cloud shadow. It was found that the computed cloud motions are within the range of the wind speeds reported from nearby upper air reporting stations. Author

N65-31374 Chicago Univ., Ill. Dept. of the Geophysical Sciences.
THE LAND AND SEA BREEZE: AN ANNOTATED BIBLIOGRAPHY
Gisela L. Baralt and Rodger A. Brown *In its* Mesometeorological Field Studies Feb. 1965 62 p refs (See N65-31369 20-20)

An annotated bibliography is presented on the land and sea breeze. The earlier papers deal with observation or qualitative theory while the more recent deal with the quantitative aspects of land and sea breeze theory. Theoretical studies in the past ten years have employed computers to handle the detailed observations. In addition to pure breeze studies, many papers emphasize factors related to the land and sea breeze. Others stress the therapeutic values of land and sea circulations and their role in forest fire control around coastal regions. Also included are studies on gravity waves, refractive index anomalies, electrical potential gradient and ionization of the air, and ground radiation balance associated with sea breezes. R.N.A.

N65-31503# Bohan (Walter A.) Co., Park Ridge, Ill.
INVESTIGATION OF FRONTAL CLOUD PATTERNS IN THE ATMOSPHERE Final Report
Walter A. Bohan Nov. 1964 12 p
(Contract CwB-10870)
(AD-617571)

TIROS IV nephanalyses for the months of March, April, and May 1962 have been examined in conjunction with six-hourly surface charts to obtain examples where TIROS photographic series passed over surface frontal zones. The geographical area covered was limited to the Northern Hemisphere and extended from Japan, across the North Pacific Ocean, the Continental United States, and the North Atlantic Ocean. A total of 216 passes over frontal zone areas were selected for presentation, to illustrate the characteristics of cloud cover patterns in frontal zones for this series. To provide information on the synoptic scale atmospheric circulation systems in the vicinity of the frontal zone areas, sectional surface and upper air charts are used. The cloud cover photographs corresponding to the nephanalyses are displayed in a mosaic format, rather than selected single photographs, to bring out, in addition to the frontal cloud cover characteristics, the synoptic scale cloud cover features in the attendant atmospheric circulations. A unique color transparency overlay format is used to present the nephanalyses and synoptic scale surface and upper air charts. Author

N65-31562# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
THE CALCULATION OF PRECIPITATION SCAVENGING
R. J. Engelmann Jul. 1965 38 p refs
(Contract AT(45-1)-1830)
(BNWL-77) CFSTI: $2.00

This review is designed to give a solid and up-to-date basis for newcomers and fringe workers in precipitation scavenging. It is also intended as a guide to quantitative predictions. Collection efficiencies, washout coefficients for particles and gases, rain spectra, and washout by snow are discussed, and values given, of which some are previously unpublished. Extensive "area within a washout isopleth" charts are shown for three atmospheric stabilities and several washout coefficients. Author

N65-31579# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
AEROBEE KP 3.10 Meteorological Data Report, 23 Jun. 1965
Marjorie Mc Lardie Hoidale Jul. 1965 35 p refs
(ERDA-326; AD-467704)

Meteorological data gathered for the launching of Aerobee KP 3.10 are presented for the Kitt Peak National Observatory, the U.S. Naval Research Laboratory, and for ballistic studies. The data appear, along with calculated ballistic data, in tabular form. Author

N65-31675# Wisconsin Univ., Madison.
A BALLOON-BORNE OPTICAL AEROSOL AND CLOUD DETECTOR
Serhij Pilipowskyj (M.S. Thesis) 1965 50 p refs
(AD-617302)

A balloon-borne aerosol and cloud detector is proposed for obtaining synoptic data on the vertical distribution of cloud and aerosol layers to a height of 30 km. The instrument measures the intensity of light scattered from a sampling volume and, if a size distribution of the particulates is assumed, their concentration can be determined. Various size distributions of hazes and clouds are considered. Their contribution, as well as that of the molecular atmosphere, to the signal detected by the instrument is calculated. A description of a laboratory model of the proposed instrument is included. Author

N65-31676# St. Louis Univ., Mo.
INTERDIURNAL TEMPERATURE VARIATIONS BETWEEN 30 AND 60 KILOMETERS
Dee G. Sullins, Jr. (M.S. Thesis) Jun. 1965 54 p refs
(AD-617309)

A rocket sounding study of time variation in atmospheric temperature over White Sands Missile Range, New Mexico, is

reported. The statistical analysis is based on all available rocketsonde information for the altitudes between 30 and 60 kilometers during the period January 1963 to May 1964. Comparisons of temperatures plotted against time and theoretical graphs led to three conclusions: there is an apparent cycle of the order of two days for temperature variations in the upper atmosphere; there exists a possibility of a shift in this cycle toward shorter periods with increase in altitude; and there is a maximum interdiurnal variation of temperature near 40 kilometers with a mean magnitude of about 8° C. The observed error variation is roughly twice that expected from the theoretical considerations. J.M.D.

N65-31690# Inter-Range Instrumentation Group, White Sands Missile Range, N. Mex. Meteorological Working Group.
METEOROLOGICAL EQUIPMENT DATA ACCURACIES
Mar. 1965 13 p
(IRIG-110-64; AD-467152)

Accuracies and operating range data for temperature, relative humidity, pressure, rainfall, wind, wind indicator, density, index of refraction, and cloud height are tabulated for surface meteorological equipment; and accuracies and operating range data for temperature, relative humidity, pressure, wind, density, atmospheric constituents, index of refraction, ionospheric parameters, and storm detection radar are tabulated for upper air meteorological equipment. A glossary of terms used in accuracies standards is included. L.S.

N65-31702# Raytheon Co., Sudbury, Mass. Space and Information Systems Div.
VEHICLE-FIXED COMPONENT INERTIAL GUIDANCE SYSTEM STUDY
Charles Broxmeyer and Howard Wishner China Lake, Calif., Naval Ordnance Test Station, Dec. 1964 115 p refs
(Contract N60530-10010)
(NAVWEPS-8668; NOTS-TP-3715; AD-617528)

The general structure of a vehicle-fixed component inertial navigation system is outlined. The portion of the computation problem pertaining to the computation of direction cosines relating two rotating coordinate frames is discussed, and the differential equations satisfied by the direction cosines is derived. A brief description is given of the principal problems encountered in the vehicle-fixed operation of components. Three algorithms for the computation of direction cosines in the single-axis case are derived. The direction cosine differential equation is solved by expansion in series and three-axis algorithms defined specialization of the correct solution. The noncommutativity problem is discussed and a method suggested for reducing errors resulting from noncommutativity. The algorithms applicable to single-axis motion are specified and combined with simple assumptions on vehicle motion, to yield sets of difference equations. The requirements of special-purpose computers designed to implement the three-axis algorithms are outlined and the general organization, and the parameters, of several computers, is given. Author

N65-31871# McGill Univ., Montreal (Quebec). Stormy Weather Group.
TIME-DEPENDENT CHARACTERISTICS OF THE HETEROGENEOUS NUCLEATION OF ICE Scientific Report No. 4
Gabor Vali and E. J. Stansbury Apr. 1965 57 p refs
(Contract AF 19(628)-249)
(MW-41; AFCRL-65-340; AD-616625)

The dependence of heterogeneous nucleation of supercooled water drops on temperature and the duration of supercooling has been studied. The rain-sized drops were placed on an oiled aluminum surface and thermoelectric refrigeration was used to provide constant cooling-rates and to maintain constant temperatures. Once-distilled tap-water and melted snow and hail were investigated. Only the first two of these showed definite time-dependent properties. The experimental results are inconsistent with the hypothesis that all drops have equal probability of nucleation (stochastic hypothesis), and also with the hypothesis that the freezing temperature of a drop is the characteristic temperature of one of the impurities contained in the drop ("singular" hypothesis). The results can be explained if the existence of a variety of nuclei is recognized, each of which is most likely to cause nucleation in a different range of temperatures, and if the nucleation probability associated with each impurity is a function of the temperature of the sample. Author

N65-31967# St. Louis Univ., Mo.
THE FREQUENCY OF RADAR DEPICTED PRECIPITATION ECHOES IN CENTRAL MISSOURI AND ILLINOIS
William E. Smurro (M.S. Thesis) 1965 94 p refs
(AD-617311)

Radar observations were made of precipitation echos in central Missouri and Illinois. Hourly overlay plots of the plan position indicator scope were made and analyzed. Echo frequencies were totaled by grid squares for monthly periods. Three year mean monthly absolute frequencies, three year mean seasonal absolute frequencies, and a three year mean annual absolute frequency were found and iso-lines of echo frequencies were drawn. The mean echo patterns show the frequency of echo occurrence decreases rapidly with range beyond sixty nautical miles. Interpretation of the range normalized charts shows that the mean echo distribution has a distinct monthly and seasonal variation with areas of maximum echo occurrence moving with a relation to the seasonal variation of frontal or convective type precipitation. The precipitation echo distribution displayed in the three year annual, seasonal, and monthly means agrees with precipitation patterns established in long term means. Factors affecting the distribution are the proximity to the main moisture source, the Gulf of Mexico, latitude, elevation and local topography, and geographic position with respect to large scale weather disturbances. R.N.A.

N65-32173*# Chicago Univ., Ill. Dept. of Geophysical Sciences.
A TECHNIQUE FOR PRECISE ANALYSIS OF SATELLITE DATA. VOL. II: RADIATION ANALYSIS. SECTION 6: FIXED-POSITION SCANNING
Tetsuya Fujita Jun. 1964 24 p
(Grant NsG-333)
(NASA-CR-58735; SMRP-RP-29) CFSTI: HC $1.00/MF $0.50
CSCL 04B

Based on a previously proposed method for the photogrammetric analysis of TIROS cloud photographs, a technique is described which focuses on the use of fixed position scanning for the precise analysis of satellite data. Included are: (1) the solution of fixed position scanning carried out by fixing the satellite position in space, (2) its extension to scanning from earth orbiting satellites which are either earth or space oriented, (3) a discussion of terrestrial scan lines leading to computations of the scan vectors and the irradiance vectors of solar radiation to clarify the directional characteristics of terrestrial radiation within the spectral ranges of scanning radiometers, (4) an analysis of the spatial response of infrared sensors in connection with the resolution of sensors, (5) the applicability of radiation analog traces to infrared mapping and interpretation, and (6) a method for use in interpreting the final meteorological radiation tape listings and the grid print maps produced through IBM-7090 computers. Considered are inherent problems associated with constructing infrared maps of terrestrial objects as clouds, ocean, and land surfaces. S.C.W.

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N65-32220# General Dynamics/Convair, San Diego, Calif.
COMPUTER ANALYSES OF METEOROLOGICAL SATELLITE DATA Final Report, Apr. 1964–Apr. 1965
W. A. Marggraf Bedford, Mass., AFCRL, Jul. 1965 134 p refs
(Contract AF 19(628)-4026)
(GD/C-DBB-013; AFCRL-65-446; AD-619163)

Computer methods were used to process and analyse Tiros video camera and infrared radiometer data. Surface temperature and albedo estimates were made by applying certain derived calibration and correction functions to the Tiros data. The surface feature characteristics for high and low cloud, water, desert, land, ice and snow areas were explored by computer generated infrared displays, frequency scatter diagrams, and an infrared data correlation process. The radiation intensities emitted from a Rayleigh scattering atmosphere and received by a Tiros video camera were computed and results tabulated. An albedo estimating algorithm was derived from this scattering model and used to generate rectified, mapper and gridded albedo mosaics from calibrated Tiros video data. Automatic cloud cover analyses such as cloud amount, average albedo per unit area, and cloud banding indicators were performed. The method of determining cloud banding information was derived using a two-dimensional power spectrum analysis. Author

N65-32349# Lockheed Missiles and Space Co., Sunnyvale, Calif.
SOME RESULTS OF MEASURING TURBULENCE IN A FREE PURE ATMOSPHERE BY A RADAR METHOD
A. A. Zagorodnikov [1964] 4 p ref Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 156, no. 6, 1964 p 1336–1338

Radar scattering by a cloud of dipole reflectors was studied as a means of determining atmospheric turbulence. Tests were conducted on reflector clouds dropped in a free pure atmosphere in the 2 to 26 km altitude range. From the experimental data the relationship rate of turbulent scatter and wind velocity, and between rate of turbulent scatter and the Richardson number, were estimated along with measures of experimental error. J.M.D.

N65-32392# Geophysics Corp. of America, Bedford, Mass. GCA Technology Div.
SYNOPTIC STUDIES OF VORTEX CLOUD PATTERNS Final Report, Apr. 1962–Nov. 1963
Edward M. Brooks and William E. Shenk Mar. 1965 169 p refs
(Contract Cwb-10817)
(GCA-TR-65-5-G)

TIROS observations of cloud vortices associated with extratropical cyclones between April 1962 and November 1963 were examined. Meteorological parameters were related to the age of the vortex, season, and geographical location as well as to the principal sounding class for the position of the station. Relative tropopause heights were estimated from the means and variances of the vertical temperature differences. The wind results showed that the wind directions within 180 nm ahead of the major cloud band axes averaged 16° clockwise, and behind the bands, 25° clockwise. The mean vertical wind shears within major cloud bands and in the day zone behind the bands were about 60° and 20°, respectively, clockwise from the band orientation. Most cloud bands were characterized by a speed convergence of the normal components, and by a cyclonic shear and vorticity of the parallel components of the mean winds on the two sides of the bands. G.G.

N65-31526# Federal Aviation Agency, Atlantic City, N. J. Research Div.
STUDY OF ATCRBS CODE ALLOCATION AND ASSIGNMENT IN A NAS ENVIRONMENT Final Report
R. A. Primeau Jul. 1965 37 p refs
(RD-65-83)

This report presents a concept for the allocation and assignment of discrete beacon codes for future employment in NAS environments. A code plan is postulated which provides for the utilization of both discrete and non-discrete codes in such a manner that: (1) the constraints placed on implementation of 4096 code utilization by the requirement for an evolutionary transition from 64 code utilization are not compromised; and (2) the concept provides for evolutionary applicability in additional NAS ATC subsystems with minimum disruption to the proposed transition code employment plan. Author

N65-31751# Federal Aviation Agency, Washington, D. C. Traffic and Economic Analysis Branch.
AN ANALYSIS OF ITINERANT AIR TRAFFIC, JACKSONVILLE ARTCC, 1970 & 1975 Interim Report
Donald L. Dunlap Aug. 1965 59 p
(RD-65-89)

This report contains forecasts of the itinerant air traffic expected to occur within the Jacksonville ARTCC control area in 1970 & 1975. The forecasts describe annual, peak day, peak hour of peak day, IFR & VFR traffic. Two possible control area configurations are described. One is the present Jacksonville ARTCC control area; the other is the combined Jacksonville-Miami ARTCC control areas. A plausable configuration of the peak hour traffic is described in terms of abbreviated flight plans which indicate type of aircraft, true air speed, origin, time of entrance into the control area, destination, and route of flight. Author

N65-32352# Federal Aviation Agency, Oklahoma City, Okla. Civil Aeromedical Research Inst.
PROBLEMS IN AIR TRAFFIC MANAGEMENT: V. IDENTIFICATION AND POTENTIAL OF APTITUDE TEST MEASURES FOR SELECTION OF TOWER AIR TRAFFIC CONTROLLER TRAINEES
Bart B. Cobb Jul. 1965 11 p refs Repr. from Aerospace Med., v. 35, no. 11, Nov. 1964 p 1019–1027
(AM-65-19)

A study of over 200 Terminal Air Traffic Control Specialists (ATCS's) indicated that their training performance could be well predicted by a composite of four aptitude tests measuring: numerical ability, nonverbal abstract reasoning, ability to solve simplified air-traffic problems, and verbal abstract reasoning. The aptitude of verbal abstract reasoning is both unique and important for the prediction of Terminal ATCS performance. In previous research, this aptitude has failed to emerge as a

valuable predictor of performance for Enroute ATCS trainees. With the exception of verbal abstract reasoning, the group of Civil Service Commission tests presently being used to select all ATCS trainees provides adequate measures of those aptitudes that this study has identified as most significant for the prediction of Terminal performance and is still appropriate for the selection of Terminal and Enroute trainees. Author

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N65-31330 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CONVERSION FROM POINT AND OTHER VERY SIMPLE SOURCES TO CYLINDER

V. I. Popov *In its* Instrs. and Methods of Radiation Analysis 4 Mar. 1965 p 8–14 refs (See N65-31329 20-24)

Conversions, consisting of determining the dose rate from a source of given form, from both calculations and experimental data, are used for designing shielding. Conversion from a point, line, and disk, to a cylinder is considered, and approximations are evaluated for cases where the cylinder is replaced by a point, line, or disk. Nomographs for determining conversion factors from point to cylinder (for axial and radial directions); for determining conversion factors from line to cylinder; and for determining conversion factors from disk to cylinder (axial direction) for varying positions of the disk on the cylinder, calculated from formulas are presented. It was shown that dimensions of a cylindrical source exist such that the dose rate changes with distance according to the law of inverse squares. Calculations also showed that for some cases, deviation from the inverse square law does' not exceed 20% to 30% even for strongly absorbing sources. For nonabsorbing cylindrical sources of given dimensions there is practically no deviation from the inverse square law. L.S.

N65-31335 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

METHOD OF NONLINEAR GRADIENT PROGRAMMING FOR CALCULATION OF MINIMUM WEIGHT SHIELDING

L. R. Kimel' *In its* Instrs. and Methods of Radiation Analysis 4 Mar. 1965 p 63–72 refs (See N65-31329 20-24)

Presented are minimum weight calculations for lead shielding of a Co^{60} radiation source of 1000 curie, where the maximum permissible dose rate region is located 3 m from the radiation source. Protection was considered for n separate protective sectors, and a step function was used to interpret n thicknesses of shielding as coordinates of a point in an n-dimensional space, where the dose of radiation at a given place, and the shield weight are functions of the coordinates of this point. Selection of the shielding form is determined by the geometric dimensions of the source of radiation and the protected region. This method is applicable to multilayer shielding and to mixed gamma-neutron radiation under certain modifications. G.G.

N65-31336 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SHIELDING FROM RADIATIONS OF ELECTRON ACCELERATORS WITH MAXIMUM ENERGY OF ACCELERATED ELECTRONS UP TO 30 MEV

L. R. Kimel', V. P. Mashkovich, and A. M. Panchenko *In its* Instrs. and Methods of Radiation Analysis 4 Mar. 1965 p 73–80 refs (See N65-31329 20-24)

A simplified method and the necessary initial data for calculations of shielding from bremsstrahlung and photoneutrons of accelerators with maximum energy of 30 MeV is described. The dose rate of bremsstrahlung is considered as a function of the electron stream on the target, the energy of the electrons, and the atomic number and thickness of the target material. Exact calculations of shielding for energies above 10 MeV were not possible due to the absence of numerical values for the attenuation factors. Photoneutron flux was evaluated as a function of maximum energy of bremsstrahlung, atomic number, and target geometry. An example is given for protective wall thicknesses of a 20 MeV accelerator at average current of 50 microamperes with a gold target of optimum thickness. The front wall thickness of the accelerator was determined by bremsstrahlung, the other wall thicknesses by photoneutron radiation calculations. G.G.

N65-31338 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SCINTILLATION GAMMA DOSIMETER

Ye. A. Kramer-Ageyev and V. K. Sakharov *In its* Instrs. and Methods of Radiation Analysis 4 Mar. 1965 p 91–98 refs (See N65-31329 20-24)

Described is a sensitive scintillation gamma dosimeter with a remote pickup that consists of a photomultiplier and a combined scintillator. This instrument attains an energy dependence compensation of ~5 percent in the energy range from 50 keV to 3 MeV by combination of an organic plastic scintillator crystal of p-terphenyl in polystyrene with a KI (T1) crystal. The dosimeter has a sensitivity of 1.9×10^{10} pulses/r and can be used only for dose rates up to 5 mc/sec. G.G.

N65-31389# Argonne National Lab., Ill.

FUEL MANAGEMENT AND INVENTORY IN THE EBR-II FUEL CYCLE

I. G. Dillon, L. Burris, Jr., and M. Levenson Mar. 1965 21 p refs (Contract W-31-109-ENG-38)
(ANL-6735) CFSTI: $1.00

To determine minimum fuel inventory requirements for the second Experimental Breeder Reactor (EBR-II), various fuel-cycle operating parameters were investigated. These included cooling time of discharged fuel; time required for fuel processing and refabrication; time between reactor shutdowns for fuel charging and discharging; and reactor power level. A burnup of 2 a/o of the heavy elements in all fuel discharged from the reactor was assumed for the calculations. Study results indicate: (1) A fuel inventory factor of about 1.4 will suffice if fuel discharged from the reactor can be returned in approximately 40 days. (2) Fuel inventory factors (total fuel/fuel in reactor) vary directly with cooling, processing, and reactor cycle times, and with reactor power level, and indirectly with degree of fuel burnup. (3) A reactor cycle time slightly longer than the out-of-reactor time would be advantageous. M.G.J.

N65-31413 European Atomic Energy Community, Brussels (Belgium).
THE APPLICATION OF X-RAY PROJECTION MICROSCOPY TO THE QUALITY CONTROL AND INSPECTION OF COATED PARTICLE FUELS FOR THE DRAGON REACTOR EXPERIMENT
J. F. G. Conde *In its* On Electron Microprobe Analysis— Quant. and Structural Analysis of Nucl. Mater. Jun. 1964 p 105–144 refs (See N65-31404 20-06) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 250 Belg. Fr.

Approximately 400 different batches of coated particle fuels have been examined by X-ray projection microscopy in connection with the Dragon High Temperature Gas Cooled Reactor Experiment. Fuel particles were in the form of spheres, 250 to 420 microns in diameter, having multi-layer coatings of pyrolitic carbon and silicon carbide of 100 to 130 microns in thickness for fission product retention. Radiographic results revealed the presence of multiple kernels, low density or unfueled kernels, and cracked fuel kernels, all of which are illustrated. Contamination of the coating was also studied; and geometry of projection and particle metrology were discussed and applicable equations were developed. The X-ray projection microscopy technique is considered useful in evaluating certain characteristics of coated fuel particles and may be important in determining irradiation behavior. The technique has been demonstrated to be a valuable method for the routine quality control and inspection of coated particle fuels on a production basis. M.W.R.

N65-31424# Battelle-Northwest, Richland, Wash.
EVALUATION OF THE ACCURACY OF DECAY SCHEME CONSTANTS AND CALIBRATION STANDARDS FOR CESIUM-137
W. Y. Matsumoto Jul. 1965 22 p refs
(Contract AT(45-1)-1830)
(BNWL-87)

Reported ranges of half-life, 26 to 33 years; beta branching ratios, 0.92 to 0.97; and total internal conversion coefficients, 0.08 to 0.12, were studied to obtain an accurate knowledge of decay scheme constants and calibration standards for Cs^{137}. A detailed review of published values showed the total internal conversion coefficient of 0.110 to be the most reliable. Values reported for the beta branching ratio since 1958 have a relative spread of about 4%, and half-life values since 1960 have a relative spread of about 10%. An experimental program of absolute beta counting and gamma-ray spectrometery was conducted on certified standards. Consistent values were obtained for: half-life, 31.1 years; beta branching ratio, 0.954; and conversion coefficient, 0.110. A weighted estimate, with all of the interrelated parameters considered, was made and showed: half-life, 30.76 years; beta branching ratio, 0.954; internal conversion coefficient, 0.110; gamma/sec/mole standard, 1.05×10^5; and atoms/mole standard, 1.71×10^{14}. C.T.C.

N65-31435# Atomics International, Canoga Park, Calif.
REACTIVITY WORTHS OF SEVERAL FAST REACTOR CONTROL MATERIALS
R. W. Campbell and S. G. Carpenter 25 Jul. 1965 21 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-11368)

A high sensitivity reactor oscillator has been used to determine the reactivity worths of a series of control rod materials in a range of spectra having median fission energies from 8.5 ev to 422 kev. The control rod materials studied were natural B, B^{10}, Eu_2O_3, Gd_2O_3, and Ta. Europium oxide was as good a poison as natural boron and better than Gd_2O_3 by a factor of 4 over the range studied. Tantalum showed good control capabilities at the higher energies and offers the advantage of a metallic form. Author

N65-31488# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
GROUP CONSTANTS FOR DESIGNING OF NUCLEAR REACTORS
L. P. Abagyan, N. O. Bazazyants, I. I. Bondarenko, and M. N. Nikolayev 18 May 1965 154 p refs Transl. into ENGLISH of "Gruppovyye Konstanty dlya Rascheta Yadernykh Reaktorov" Moscow, Atomizdat, 1964 p 1–139
(FTD-MT-65-45; AD-615389)

The use of multigroup systems of constants for designing nuclear reactors in the U.S.S.R. is described. The principles of composition and the use of these constants for fast and intermediate neutrons are discussed, with emphasis on the selection of energy intervals of groups; calculation of heterogeneous resonance effects; and determination of the deceleration cross section. Among the data surveyed for obtaining the values were fission cross sections; average number of secondary neutrons; neutron fission spectrum; capture cross section; inelastic scattering; and angular distribution of elastic scattering. The enveloped elements and isotopes included basic reactor materials for which the composition of complete systems of constants has meaning; and energy intervals were subdivided to ensure use of the systems for various reactor designs. Tables of group constants are also included. W.M.R.

N65-31560# Argonne National Lab., Ill.
DEVELOPMENT OF A PROCESS FOR MANUFACTURING ZPR-III U-Pu-Mo TEST FUEL ELEMENTS
A. B. Shuck, E. M. Pilarski, A. G. Hins, and G. Burton, Jr. Mar. 1965 44 p refs
(Contract W-31-109-ENG-38)
(ANL-6955)

This report describes the work performed to determine the design and fabrication processes to manufacture uranium–plutonium alloy fuel elements for Zero Power Reactor III (ZPR-III) critical experiments. These fuel elements consist of vacuum-cast uranium–plutonium–molybdenum alloy fuel plates sealed in stainless steel jackets. Four areas were investigated: (1) fuel-plate casting, (2) jacket design and fabrication, (3) fuel-element-assembly techniques to produce fuel elements free from alpha contamination, and (4) jacket seal welding and weld-casting of bearing shoes. Sample fuel elements were manufactured as described to test the feasibility of the process. Author

N65-31563#. Battelle-Northwest, Richland, Wash.
ENVIRONMENTAL TESTS OF CANDIDATE MATERIALS FOR THE HIGH TEMPERATURE LATTICE TEST REACTOR
D. P. O'Keefe Jul. 1965 28 p
(Contract AT(45-1)-1830)
(BNWL-92) CFSTI: $2.00

The results of environmental tests are given for the high temperature alloys TD nickel, nickel 200, Hastelloy B, Hastelloy X, inconel 625, inconel 600, molybdenum, Hastelloy X-Gd, and protective coatings on Hastelloy X. The test procedures are outlined, and the results are tabulated. Test specimens were exposed for periods up to 840 hr to a nitrogen–graphite environment at 1000° C or 1200° C. The most pronounced effect on the metallic specimens was carburization of alloys containing carbide formers. The TD nickel and nickel 200 showed

the least effects. Hastelloy B and inconel 600 displayed limited serviceability, but were more stable than nickel when in contact with refractory brick. Embrittlement occurred in Hastelloy X, inconel 625, and Hastelloy X with coatings of aluminum and ceramic. Reactions between granulated B_4C and nickel, and powdered UO_2 and nickel resulted in low melting alloys. Aluminum nitride was found to be stable, but boron nitride decomposed in the simulated reactor environment. C.T.C.

N65-31564# Battelle-Northwest, Richland, Wash.
THERMAL STUDIES HASTELLOY X METALLIC INSULATION
J. P. Hickerson Aug. 1965 14 p
(Contract AT(45-1)-1830)
(BNWL-102) CFSTI: $1.00

A study designed to determine the suitability of Hastelloy-X wire wool as an exterior thermal insulation material for Advanced Test Reactor (ATR) gas loop piping is reported. Presented are thermal conductivity data for two 12-1/4 in. long half-cylindrical segments which were obtained using a cylindrical, axially heated furnace designed to provide strictly radial heat flow. Described are furnace design and construction methods, instrumentation used in temperature measurements, and operational procedures. The operational performance of the furnace was satisfactory at all temperatures with few exceptions. Visual inspection of the metallic insulation after furnace dismantling revealed no adverse effects to the wire wool or its sintered bonds, except where the wire wool had contacted the stainless pipe. S.C.W.

N65-31567# Union Carbide Nuclear Co., Oak Ridge, Tenn.
REVIEW OF HYDRAULIC PROBLEMS ON THE BONUS REACTOR PRESSURE CONTROL SYSTEM
I. G. Speas, J. S. Cobb, and S. E. Groothuis 25 Aug. 1965 46 p
(Contract W-7405-ENG-26)
(Y-1491)

Y-12 Engineering personnel made a study of the BONUS reaction pressure control system to determine the cause of the malfunction of the hydraulic controls on the major steam valves. It was concluded that the principal contributor to the valve trouble was the high moisture content of the phosphate–ester hydraulic fluid. This excessive moisture reacted with the hydraulic fluid to produce an acid which, in turn, corroded the steel components of the system and produced fine abrasive particles that eroded the servo metering surfaces. Modifications were recommended that should alleviate the current problems. Author

N65-31569# Mound Lab., Miamisburg, Ohio.
REACTOR FUELS AND MATERIALS DEVELOPMENT PLUTONIUM RESEARCH: JANUARY–MARCH, 1965
L. J. Wittenberg and G. R. Grove 18 Aug. 1965 16 p refs
(Contract AT(33-1)-GEN-53)
(MLM-1262)

Progress is reported on the development of plutonium reactor fuels and materials. The phase equilibria in the plutonium–cerium–iron system were investigated. Tie lines for the $CeFe_2$–$PuFe_2$ solid solution were established, a nonequilibirum liquid was detected below the minimum solidus temperature of the system, and an increase in the transformation temperature of hexagonal beta cerium from −10° to 397° C resulted from the addition of as little as 2 at.% Fe. Investigations of plutonium-yttrium-gadolinium and plutonium-yttrium-neodymium indicate that the maximum solid solubility is between 20 and 30 at.% plutonium in each system. The measured density of liquid neodymium decreased from 6.670 g per cc at 1035° to 6.583 g per cc at 1231° C. Investigation continued of the relation between viscosity and composition in the liquid plutonium–cerium alloy system. Construction details are given for a high temperature calorimeter designed for high precision heat capacity measurements of plutonium bearing materials. An examination of uranium dioxide microspheres melted in an induction coupled plasma torch revealed small inclusions which were tentatively identified as uranium metal. R.N.A.

N65-31703# Atomics International, Canoga Park, Calif.
AEC UNCLASSIFIED PROGRAMS, FISCAL YEAR 1964 Annual Technical Progress Report
31 Aug. 1964 414 p refs
(Contract AT (11-1)-GEN-8)
(NAA-SR-9999) CFSTI: $5.00

Progress is reported in the following areas: (1) advanced sodium cooled reactors—sodium reactor experiments, operational support, power expansion program, safety analysis, and engineering surveillance; (2) Hallam nuclear power facility—fuel surveillance program, performance evaluation of fuel elements in the Hallam reactor, and providing equipment, methods, and procedures to perform preirradiation and postirradiation examinations of fuel elements; (3) advance organic moderated reactors—organic cooled reactor development; (4) reactor safety—study of reactor housing installations, atmospheric ddecontamination in reactor accidents, fission product retention by reactor coolants, reactor kinetics, measurement of Doppler coefficients, boiling studies for sodium reactor s fety, sodium fires and fission product release, and fuel element transient heating studies; (5) separations chemistry—process initiation (refractory fuels), multicycle reprocessing basic separations (uranium), and new process development; (6) and studies in the advanced development program—reactor physics, study of BeO as a reactor material, continuous neutron flux monitor, radiation damage in crystalline solids, and isochronal annealing spectra. R.R.D.

N65-31716# Argonne National Lab., Ill.
A FEASIBILITY STUDY OF THE APPLICATION OF A DIGITAL DATA ACQUISITION AND PROCESS CONTROL SYSTEM TO A RESEARCH REACTOR
G. C. Vellender Jan. 1965 67 p refs
(Contract W-31-109-ENG-38)
(ANL-7009) CFSTI: $4.00

This report discusses the advantages of the digital data acquisition and control system. The report considers, in detail, the digital data system characteristics and the techniques of application. The discussion includes such topics as: accuracy, speed of data sampling, process-transducer characteristics, word length, equipment reliability, electrical noise susceptibility and emanation, input/output subsystems, programing, utility requirements, and service conditions. A test-evaluation installation is proposed. A complete system specification and cost estimate are also included. Author

N65-31738# Atomics International, Canoga Park, Calif.
SNAP 10A PbSnTe T/E PUMP S/N-022 ACCEPTANCE TEST
C. M. Quirk and T. M. Funakura 14 Jul. 1964 21 p
(Contract AT(11-1)-GEN-8)
(NAA-SR-10199)

The results of an acceptance test of the SNAP 10A PbSnTe thermoelectric pump S/N-022 are presented. The maximum ouput obtained during the orbital full flow test was measured as 15.54 gpm of 1010° F NaK at a pressure of 1.119 psi. The

maximum output obtained during the pre-reactor test was measured as .36 gpm of 90° F NaK at a pressure of .00584 psi, with a startup dc current of 40 amperes. Based on these test results, the pump met the requirements for the orbital full flow test but did not meet the pre-reactor startup requirements. R.N.A.

N65-31739# Atomics International, Canoga Park, Calif.
STATIC CHECK VALVE EVALUATION
I. E. Randall 28 Jul. 1964 22 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-10239)

The use of static check valves in the Mercury Rankine system was considered due to their ability to reduce the system weight by a small, but appreciable, amount. Two types of static check valves were considered; the Tesla valve and an orifice-nozzle device. The Tesla valve splits the fluid stream and turns part of it against the main flow causing a high flow resistance due to momentum bucking. It acts preferentially, and creates a higher flow resistance in one direction than in the other. The orifice-nozzle device utilizes the difference in frictional resistance of an orifice and a venturi. In forward flow the device acts as a venturi and presents a low frictional resistance but in reverse flow a higher frictional resistance is presented when the device acts as an orifice. Results of an analytical study and prototype tests show that a Tesla valve cannot meet the system requirements for the Mercury Rankine system. The minimum required ratio of reverse to forward flow resistance is 306:1. The best produced by the test was only 2:1, and the best anticipated ratio was about 16:1. A mathematical study of the Tesla loop was also started with a potential flow model to gain an understanding of the phenomenon. R.W.H.

N65-31761# Atomics International, Canoga Park, Calif.
SNAP 10A NaK LOADING CART ACCEPTANCE TEST
N. D. Huse and T. M. Funakura 10 Jul. 1964 29 p ref
(Contract AT (11-1)-GEN-8)
(NAA-SR-MEMO-10169)

Testing of the modified SNAP-10A NaK loading cart is reported. The final check-out test system consisted of an external loop connected to the supply and return lines of the NaK cart. The external loop included an extra fill tank, a Blake resistivity rhometer, an external NaK flow indicator loop, and the NaK sampling section. A total of 350 pounds of NaK was cleaned by cold trapping to a quality acceptable for the SNAP unit loading and verified by the performance of eleven NaK plugging tests. The problems and their solutions in the check-out tests are presented, along with general discussion of the performance of the loading cart. J.M.D.

N65-31767# Atomics International, Canoga Park, Calif.
SNAP 10A PbSnTe T/E PUMP S/N-027 ACCEPTANCE TEST
C. M. Quirk and T. M. Funakura 24 Jun. 1964 20 p
(Contract AT-11-1-GEN-8)
(NAA-SR-MEMO-10143)

The acceptance testing of the SNAP-10A PbSnTe pump is reported. The maximum output during the orbital full flow test was 16.44 gpm of 1010° F NaK at 1.108 psi. The maximum output during the pre-reactor startup test was 0.41 gpm of 90° F NaK at 0.0059 psi at a startup current of 40A. Based upon these results, the pump meets the requirements with regard to the orbital full flow but does not meet the pre-reactor startup test specifications. E.E.B.

N65-31773# Atomics International, Canoga Park, Calif.
SNAP 10 PbSnTe T/E PUMP S/N-026 ACCEPTANCE TEST
C. M. Quirk and T. M. Funakura 5 May 1964 21 p ref
(Contract AT(11-1)-GEN-8)
(NAA-SR-MEMO-9877)

The SNAP 10A PbSnTe T/E Pump S/N-026 was Acceptance Tested in accordance with Test Specification NA0204-005, Revision "A", and data as obtained, is submitted with a short summary of the results. The maximum output obtained during the Pre-Reactor Startup Test was measured as .33 gpm of 90° NaK at a pressure of .006 psi, with a startup current of 40 amperes D. C. The maximum output obtained during the Orbital Full Flow Test was measured as 15.45 gpm of 1010° F NaK at a pressure of 1.093 psi. Based on the results of the above tests, T/E Pump S/N-026 meets the requirements of the test specification with regards to the "Orbital Full Flow Test" but does not meet the "Pre-Reactor Startup" requirements. Author

N65-31799# United Kingdom Atomic Energy Authority, Harwell (England). Chemical Engineering Div.
CLOUD FORMATION AROUND BUBBLES IN GAS FLUIDISED BEDS
P. N. Rowe, B. A. Partridge, and E. Lyall May 1965 8 p
(AERE-R-4543, Amendment 1)

Reported is an amendment to a previous report on cloud formation around bubbles in gas fluidised beds. Presented are revised data for describing the cloud shape that will form around an assumed spherical bubble as seen in a vertical plane through the bubble center, which were erroneously reported in the section entitled "Probable size and shape of three-dimensional clouds." Included are revised figures showing corrected shapes and points for subsequent curves. On the basis of revised calculations, it is shown that the observed particle wake will affect cloud shape (Murray's shape). An important result of revised data is that Murray's shape now agrees closely with Jackson's, and Murray's curve passes through Jackson's point. S.C.W.

N65-31800# Battelle Memorial Inst., Columbus, Ohio.
PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING MAY, 1965
Russell W. Dayton and Stan J. Paprocki 1 Jun. 1965 45 p refs
(Contract W-7405-ENG-92)
(BMI-1727) CFSTI: $1.00

Continued research having the general objective of providing support to the Atomic Energy Commission's overall reactor development program is reported. Presented are reports relating to civilian applications in the following areas: reactor materials and components; fuel studies; radioisotope and radiation applications; coated-particle fuel materials; and the gas-cooled reactor program. Among the research cited are included: studies of the fretting characteristics of spacer-clip materials for Zircaloy-clad fuel elements in 550° F water; studies on the thermal stability of $Zr-O_2$-base fuels; research on radiation-induced formation of organometallic compounds with particular emphasis on organotins; fuel-particle, carbon-coating, and in-pile irradiation studies; and studies designed to determine the irradiation stability of UO_2 in $Zr-O_2$ in comparison with UO_2 and UO_2 in BeO. S.C.W.

N65-31812# Battelle-Northwest, Richland, Wash.
TESTING OF IMMERSION HEATERS FOR IN-TANK SOLIDIFICATION CIRCULATORS
J. Dunn Jul. 1965 17 p ref
(Contract AT(45-1)-1830)
(BNWL-101)

The use of direct immersion electric heaters is proposed for concentrating intermediate level wastes in underground tanks. A series of tests has been completed to investigate the major technical concern with this concept (that of scale deposition on the heat transfer surfaces). Tests were performed with simulated coating wastes, concentrated up to four times the original volume, and containing either 0 or 1% added sodium sulfate or phosphate. Power density of the heaters ranged from 17 to 500 W/in.^{2}. No scale deposition on heated surfaces occurred in either bench- or pilot-scale tests during any of the tests; maximum test duration was approximately 2600 hr. Based on the heater performance and on the absence of scale on the heated surfaces, an electric heater prototype is recommended for testing under plant conditions. Author

N65-31877# Battelle-Northwest, Richland, Wash.
CORROSION IN SIMULATED PRTR FUEL ELEMENT SURFACE CREVICES
W. K. Winegardner Jul. 1965 26 p refs
(Contract AT(45-1)-1830)
(BNWL-83) Available from AEC, Oak Ridge, Tenn.: $2.00

Two out-of-reactor tests were conducted to study corrosion of Zircaloy-2 in crevices with geometries similar to those existing on heat transfer surfaces of Plutonium Recycle Test Reactor fuel elements. The tests were conducted in high temperature (293° C), lithiated water at a pH of about 10 and used electrically heated, Zircaloy-2 clad test assemblies. Heat flux associated with heated crevices was about 1100 W/in^2. Examination after 70 days of loop exposure revealed test assembly cladding penetration, up to 0.007 in., in heated crevices. It is felt that the accelerated attack was the result of the concentration of lithium hydroxide by local boiling. Author

N65-31914# Reactor Centrum Nederland, The Hague.
A STUDY OF CELL PARAMETERS USING THE K-7-THERMOS NEUTRON THERMALIZATION CODE
W. A. Raajmakers Brussels, EURATOM, 1965 34 p ref
(Contract EURATOM-007-61-6 PNIN)
(EUR-2181.e) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 50 Belg. Fr.

The present report is intended to show some of the results obtained with the K-7-THERMOS code. This code is specifically designed for neutron spectra and flux calculations in small as well as large reactor cells with cylindrical symmetry and is based on principles by Honeck. A short description of the code itself will be given as well as details related to the theory. The actual calculations were carried out on a Ferranti-Mercury computer. Author

N65-31922# European Atomic Energy Community, Brussels (Belgium).
ON A DERIVATION OF THE MULTIGROUP KINETIC EQUATIONS OF COUPLED REACTORS
D. Schwalm 1965 22 p refs
(EUR-2416.e) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 40 Belg. Fr.

Starting from the time dependent Boltzmann equation, a multigroup multipoint kinetics is derived. The coupling parameters are expressed in terms of leakage probabilities, which can be calculated for the stationary state. In particular, it shown that the well-known concept of a pseudo group of precursors for a reflected reactor cannot be used in a multigroup treatment. Author

N65-31924# European Atomic Energy Community, Brussels (Belgium).
"DRAGON" REACTOR AUTOMATIC CONTROL EQUIPMENT [APPARECCHIATURA DI CONTROLLO AUTOMATICO DEL REATTORE "DRAGONE"]
M. Franchi, A. Garroni, and F. Sciuto 1965 54 p refs in ITALIAN; ENGLISH Summary
(EUR-2422.i) Available from Belg. Am. Bank and Trust Co., New York, Account No. 221.86: 70 Belg. Fr.

This report describes the DRAGON reactor automatic control equipment, regulating the cooling gas outlet temperature and the power. This special purpose electronic controller is entirely made with solid state devices. Author

N65-31957# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
ADVANCED, GRAPHITE-MATRIX, DISPERSION TYPE FUEL SYSTEMS Annual Report, Apr. 1, 1963–Mar. 31, 1964
J. C. Bokros, W. Y. Goeddel, J. R. Hooker, H. K. Lonsdale, J. L. White et al [1964] 55 p refs
(Contract AT(04-3)-167)
(GA-5016, Pt. 1)

The structure of pyrolytic carbon deposited in a fluidized bed is being characterized in order that its physical and mechanical properties can be related to structure. The feasibility of applying hot working processes to the fabrication of graphite matrix fuel bodies of improved properties is being determined, and the properties of hot worked bodies containing carbide particles are being defined. The synthesis and evaluation of improved binders for graphite are being extended, and the optimum processing conditions for the preparation of graphite compacts with these binders are being determined. The rates of diffusion of uranium and thorium in pyrolytic carbons typical of those employed in graphite matrix fuel systems are being determined. The release of fission products from pure crystalline UC_2 and (Th, U)C_2 particles is being studied as a function of particle and crystalline size and coating type, and promising graphite matrix fuel compacts resulting from the developmental studies are being evaluated. R.N.A.

N65-32013# Argonne National Lab., Ill.
SPECTRAL REPRESENTATION AND CRITICALITY PROBLEM OF A TWO-REGION CELL TRANSPORT OPERATOR
Israel Pollack and Erwin Bareiss Mar. 1965 41 p refs
(Contract W-31-109-ENG-38)
(ANL-6590) CFSTI: $2.00

A solution of the transport equation to determine accurate conditions for the criticality of a two-region fuel-moderator assembly with reflecting boundaries is presented. The spectrum of the corresponding transport operator and the corresponding singular eigendistributions for each region are determined. It is shown that the flux distribution and criticality condition for a two-region reactor cell with reflecting boundaries can be determined by the Case method. Also, an equation is derived for the determination of the accuracy of approximate solutions of the criticality problem. E.E.B.

N65-32133# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
REACTOR SHIELDING CALCULATIONS BY THE MONTE CARLO METHOD
T. M. Jordan [1965] 29 p refs Presented at the ANS-ANL-ENEA Intern. Conf. on the Appl. of Computing Methods to Reactor Probl., Argonne, Ill., 17–19 May 1965 *Its* Paper No. 3271

This paper outlines Monte Carlo techniques for the numerical solution of the energy-dependent Boltzmann equation for neutrons or gamma rays, which significantly reduce the computer time required for Monte Carlo shielding calculations. This reduction is a maximum for calculations involving multi-energy source and/or interaction spectra and complicated source, shield, and system geometries. The Monte Carlo techniques include the use of energy independent biasing functions, energy-dependent samples which span the entire energy range of interest, and analytic integrations of the energy dependence of the differential angular-energy interaction cross sections. Typical numerical results obtained from the Monte Carlo computer program are presented to demonstrate the accuracy, flexibility and computational speed achieved through the use of these techniques. Author

N65-32198*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

DESIGN STUDY OF A FISSION–ELECTRIC CELL REACTOR

Jerome L. Shapiro 1 Aug. 1965 25 p refs
(Contract NAS7-100)
(NASA-CR-64452; JPL-TR-32-741) CFSTI: HC $1.00/MF $0.50 CSCL 18K

A design approach is developed for the application of a fission–electric cell reactor to the generation of power in space. For a graphite-moderated reactor, the total size, temperature, and total (thermal) power are fixed. The remaining parameters, including cell dimensions and voltage, are then selected to optimize the overall efficiency. To simplify the calculations, two-group reactor theory is used, investigating both the single-region and two-region core concepts. From the standpoint of overall efficiency, it is shown that the two-region core is advantageous only for low-efficiency systems and hence offers little promise. Another important result of these calculations is that the optimum operating voltage is shifted downward from the optimum as calculated without considering criticality limitations. This means that the maximum efficiency achievable is reduced considerably and indicates that the criticality requirement may be a more severe limitation on efficiency thatn the effect of voltage breakdown within the cell. Author

N65-32259*# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.

PRECRITICAL CALCULATIONS FOR THE 2.9 IN. PITCH, TWMR CRITICAL ASSEMBLY

J. C. Peak and J. M. Lovallo 1 Aug. 1965 19 p refs
(Contract SNPC-27)
(NASA-CR-54644; GA-6633) CFSTI: HC $1.00/MF $0.50 CSCL 18I

Continued research conducted under a program designed to determine the feasibility of an isotopically enriched tungsten water moderated reactor for use as a nuclear rocket is reported. Results of a parallel study developed to generate accurate and detailed information from reactor analysis and basic critical experiments for the corroboration of the calculated nuclear characteristics of the reactor concept, are presented. The first of a series of critical assemblies was fabricated and precritical neutronic calculations performed. Presented are critical loadings data and precritical calculations for the 2.9 inch pitch core with water reflectors. Also included are criticality calculations for the three-inch pitch as-built core. S.C.W.

N65-32260*# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.

GAS CAVITY REACTOR SIMULATION EXPERIMENT Final Report

G. D. Pincock and J. F. Kunze 27 Aug. 1965 17 p refs
(Contract NAS3-6104)
(NASA-CR-54653) CFSTI: HC $1.00/MF $0.50 CSCL 18I

This report contains the critical experiment test results from measurements performed in the center of the NASA Tungsten reactor to simulate a gaseous fueled cavity reactor. Gaseous UF_6 fuel was simulated with the same amount of solid sheet fuel distributed over the same volume and the reactivity difference between the two types of fuel was measured. It was found that the sheet fuel was worth about 6% less than the gaseous UF_6 fuel. Author

N65-32311# Commissariat al'Energie Atomique, Paris (France)

SINTERED URANIUM OXIDE—SINTERING TECHNIQUE—BEHAVIOR UNDER IRRADIATION Quarterly Report No. 14, 1 Jan.–31 Mar. 1964

[1964] 22 p Transl. into ENGLISH from French
(Contract EURATOM-031-60-10 RDF)
(EURAEC-1063)

The apparent out-of-pile heat conductivity of UO_2 sintered under helium, argon, and hydrogen gases was measured both qualitatively and quantitatively to confirm the role of the thermal barrier played by cracks. Results indicate that the influence of filling gas depends on the diametrical fuel-can clearance. In addition, three tests were made on sintered UO_2 samples for the purpose of in-pile measdring the direct release of fission gases at 970° C, 1115° C, 1400° C, 1500° C, and at 1850° C during irradiations in the Medicus loop. Results indicate that at 1500° C the release of gases cannot be explained by the fission recoil theory. It is likely that at least one other phenomenon, such as the ejection of gas atoms the length of the fission track, intervenes in the release. For temperatures above 1800° C, the release of the gases was not integral, and the quantity released varied with the isotopes. Also, in the whole temperature field, monocrystals release fractions of gas that are substantially weaker than polycrystalline samples. Graphs of test measurements are included. L.S.

N65-32358# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Sci.

A STUDY OF A GAS-COOLED FAST BREEDER REACTOR INITIAL STUDY CORE DESIGN ANALYSIS AND SYSTEM DEVELOPMENT PROGRAM Final Summary Report

Oak Ridge, Tenn., AEC, 15 Aug. 1964 267 p refs
(Contract AT(04-3)-167)
(GA-5537) CFSTI: $6.00

Presented is a core design study that includes plant layout and boiler design for gas-cooled fast breeder reactors. Results show that the use of gas cooling makes it possible to design cores of a high internal conversion ratio, with very low burnup reactivity changes, and with low coolant void effects. This high internal conversion ratio allows a high degree of flattening and materially reduces irregularities in power distribution. The minimal reactivity associated with a gas coolant relaxes the need for a high Doppler coefficient and permits the safe use of a harder spectrum. Some sample cases which illustrate the kind of reactor proportions and performances to be expected in 500-Mw(e) and 1000-Mw(e) ranges are discussed. A reference design based on a 5000-litre core and operating within 2100° C oxide fuel temperature is also presented, and the outline of a suitable development program is given. G.G.

N65-32368# Pratt and Whitney Aircraft, Middletown, Conn. Canel Nuclear Physics Lab.
OPERATING LIMITS AND SAFETY ANALYSIS FOR SPLIT-TABLE, DRY, FLEXIBLE CRITICAL EXPERIMENTS AT THE CANEL NUCLEAR PHYSICS LABORATORY
E. L. Paradis, W. F. Welsh, L. E. Kapinos et al Aug. 1965 62 p
(Contract AT(30-1)-2789)
(PWAC-475)

Operating limits are presented for split-table, dry, flexible critical experiments. The operating limits cover those operating variables which are measurable and under the control of the operating group and those operating and administrative procedures which can significantly influence safe operation. Past operational safety practices have been consistent with the specific limits imposed on the operating variables. Also, a safety analysis is presented to demonstrate the safety of operating within the specified limits. Further, an analysis of accidents and the calculation of effects on surrounding areas are included. E.E.B.

N65-32389# United Kingdom Atomic Energy Authority, Windscale (England).
FACILITIES FOR THE POST-IRRADIATION EXAMINATION OF CERAMIC FUEL ELEMENTS AT WINDSCALE
J. Valley 1965 45 p refs
(TRG-932(W)) HMSO: 10s

This report describes in some detail the extensive facilities in use at Windscale for the post-irradiation examination of ceramic fuel elements. In addition to the examination of both driver charge and experimental fuel elements irradiated in the Windscale AGR, the facilities can be used to examine a wide range of design of ceramic fuel elements irradiated in materials testing reactors. Author

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N65-31275# Joint Publications Research Service, Washington, D. C.
IZVESTIYA VUZov: RADIOPHYSICS, VOLUME VIII, NO. 2, 1965
10 Aug. 1965 289 p refs Transl. into ENGLISH of Izv. Vyssh. Ucheb. Zaved., Radiofiz. (Gor'kiy), v. VIII, no. 2, Mar.–Apr. 1965 p 219–428
(JPRS-31488; TT-65-31984) CFSTI: $6.00

Translations of Russian articles on electromagnetic radiation research and associated phenomena of interest to students in radiophysics are presented. For individual titles see N65-31276–N65-31305.

N65-31297 Joint Publications Research Service, Washington, D. C.
ENERGY RELATIONSHIPS AT THE BOUNDARY OF A NONLINEAR MEDIUM
V. F. Marchenko *In its* Izv. VUZov: Radiofiz., Vol. VIII, No. 2, 1965 10 Aug. 1965 p 243–248 refs (See N65-31275 20-23) CFSTI: $6.00

A method is given for calculating the magnitude of the power of any frequency arising at the boundary of a nonlinear dielectric if the characteristics of the crystal and the magnitude of the incident radiation are known. Equations for the refracted and reflected waves in the boundary region are considered valid only for those cases when the space interaction of the waves in the crystal may be ignored because of the smallness of the layer formed at the boundary. Two approximations are offered for the solution of the wave equation, and energy relationships at the boundary are calculated. M.W.R.

N65-31362 Stanford Univ., Calif. Instrumentation Research Lab.
THE BIOLOGICAL EXPLORATION OF MARS
Elliott C. Levinthal 6 Nov. 1963 *In* Space Technol. Labs., Inc. Selections from the TRW Space Technol. Labs. Lecture Ser., Vol. 2, 1965 p 14–21 ref (See N65-31360 20-34)
(Grant NsG-81-60)

Life-detection instruments for the biological exploration of Mars are discussed, and possible experiments dealing with the design of these instruments are investigated. The Multivator, an instrument for measuring the abundance of bacteria and microorganisms in Martian soil, is described in detail. Instrumentation developments in microscopy and ultraviolet absorption spectroscopy are also reported. M.R.W.

N65-31365 Stanford Univ., Calif. Dept. of Physics.
THEORETICAL ASPECTS OF THE SPACE RELATIVITY-GYROSCOPE EXPERIMENT
L. I. Schiff 23 Jun. 1964 *In* Space Technol. Labs., Inc. Selections from the TRW Space Technol. Labs. Lecture Ser., Vol. 2 1965 p 47–50 refs (See N65-31360 20-34)

Theoretical aspects of experiments designed to verify the general theory of relativity are discussed. The assumptions and predictions of Newton and Einstein concerning relativity are deliberated. Three experimental verifications, predicted by Einstein, are evaluated. These are: 1) the gravitational shift to longer wavelengths (red shift) of light going from a stronger to a weaker gravitational field; 2) the deflection of starlight that passes through the strong gravitational field close to the surface of the sun; and 3) the slow rotation of the major axis, or precession of the perihelion, of the elliptical orbit of an inner planet, Mercury in particular. A fourth experiment is proposed which consists of moving a torque-free spherical gyroscope through the gravitational field of the earth, and observing the spin axis that is of gravitational origin. The equipment will be installed in a satellite, so that F=0 and there is no Thomas precession. The geodetic precession for moderate altitude will then be about 7 seconds of arc per year, and the Lense–Thirring precession about 0.1 second per year. M.R.W.

N65-31448# Illinois Univ., Urbana. Dept. of Physics.
ADVANCES IN MOSSBAUER EFFECT METHODOLOGY HIGH PRESSURE TECHNIQUES
R. Ingalls [1964] 9 p refs
(Contracts Nonr-1834(05); AT(11-1)-1198)
(COO-1198-255)

Development by Drickamer and his co-workers of a high pressure cell for Mössbauer measurements permits investigation of isomer shifts, hyperfine fields and recoilless fractions as a function of lattice parameter. The method employed, that of supported pistons, is applicable to the study of Mössbauer sources, in the form of a foil or powder, over the pressure range of 0–300 kb. Because of the amount of support material and sample size, the method has, so far, only been applied to sources. In this paper, the pressure cell, its loading and calibration are discussed in detail. Author

N65-31479# New York Univ., N. Y. Dept. of Mathematics.
TOPICS IN THE THEORY OF TRAJECTORIES FOR A PARTICLE
James Biscardi, Jr. (M.S. Thesis) Jun. 1965 81 p refs
(AD-617278)

Equations of motion for ballistic projectiles under particular conditions are derived. In three separate cases, the trajectories are determined under the assumption that there is no air resistance, that the drag is dependent solely on the velocity of the trajectory, and that the air resistance varies as the square of the velocity. The last two cases are realistic under conditions of high and low ballistic velocities respectively. Bombing from airplanes is studied; the so-called hitting conditions are derived and a mechanical device is constructed which, though possibly impractical, solves the hitting problem. The final topic considered is the problem of rocket dispersion due to lift during the after-burning stage. J.M.D.

N65-31482# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COSMIC VELOCITIES AND THE RESISTANCE OF MEDIA. NEW THEORIES AND CHEMICAL PHENOMENA AT HIGH VELOCITIES
G. I. Polrovskiy 1 Jul. 1965 10 p Transl. into ENGLISH from Priroda (Moscow), no. 3, 1962 p 105–107
(FTD-TT-65-614/1+2+4; AD-617685)

The laws for resistance of a medium to the motion of bodies at various velocities in air of different densities are briefly reviewed, and the associated phenomena of heating, vaporization, and burning of the body material are discussed. If the rate of motion exceeds three times the velocity of sound, the corresponding temperature from the impact of air molecules over the moving body increases to 900°C and induces physical and chemical changes in the body material. An incandescent gas envelope consisting of air and vapor from the body material forms, the resistance to motion increases proportionally to the transverse cross section of the gaseous mantle and leads to burning of the body material. The destruction rate of the moving body material is increased if it has a high electrical conductivity and free emission of electrons. G.G.

N65-31501# Picatinny Arsenal, Dover, N. J. Feltman Research Labs.
THE FUNDAMENTALS OF MATERIALS RESEARCH. PART I: VISCOELASTICITY
Julian L. Davis Apr. 1965 80 p refs
(PA-TR-3202; AD-461271)

This is the first of a series of reports on certain aspects of materials research, emphasizing the field of rheology. Part I is essentially devoted to the fundamentals of macroscopic viscoelasticity. Chapter 1 gives an account of the viscoelasticity of discrete Voigt and Maxwell models. Chapter 2 gives an excursion into some general properties of continuous media, emphasizing the two methods of describing such media—the Lagrangian and the Eulerian representations. This leads to the concept of compression ratio by invoking the conservation of mass. Chapter 3 presents those elements of matrix theory necessary to an understanding of Chapter 4—"Three-Dimensional Strain." Chapter 5 discusses the equations of motion for an isotropic Hookean elastic solid. This information will be used as a basis for the discussion of stress waves in a viscoelastic medium—to be presented as a chapter in a subsequent report, which will be designated Part II. Chapter 6 contains some aspects of the author's theory of nonlinear viscoelasticity. Author

N65-31521# Lockheed Missiles and Space Co., Sunnyvale, Calif.
GREEN-VOLTERRA FORMULA IN THE NONLINEAR THEORY OF ELASTICITY
N. A. Kil'Chevskii 6 Dec. 1963 4 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Urk. RSR. (Kiev), no. 11, 1964 p 1460–1462

Previous results on the analytical mechanics of shells are extended to the space-time manifold and the generalization of the Green-Volterra formula is obtained as the four-dimensional analog of the integral relations which express the theorem on reciprocity of work. As in the former considerations, elastic anisotropic media with physical and geometric nonlinearities are examined. E.E.B.

N65-31530# Israel Academy of Sciences and Humanities, Jerusalem. National Committee for Space Research.
REPORT ON SPACE ACTIVITIES 1964–65
Apr. 1965 17 p ref

Reported are the various programs, as well as theoretical and experimental space activities, of the following Israeli institutions: *The Hebrew University of Jerusalem*—circulation of planetary atmospheres, meteorological rocket observation data, solid propellants, spectra of multiple ionized atoms, nonthermal radiation from plasmas, and other research; *The National Physical Laboratory of Israel*—selective surfaces for use in solar energy measurements; *The Weizmann Institute of Science*—terrestrial spectroscopy, cosmic rays, isotope production studies, development of mechanochemical engines, etc.; *Israel Institute of Technology*—pressure tranducers for sounding rocket payload, moonwatch activities, IQSY activities, etc.; *Tel-Aviv University*—one-dimensional solution of the Boltzman equation, plasma oscillations, dust sampling, motion of spheres falling in a viscous medium, etc.; *Ministry of Defense*—development of research rocket, etc.; *Radio Observatory, Haifa*—construction of observatory for ionospheric studies. G.G.

N65-31677# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PHYSICISTS PEEK INTO THE FUTURE
N. N. Sirota 24 May 1965 8 p Transl. into ENGLISH from Sovet. Belorussiya (Minsk), 1 Jul. 1964 p 3
(FTD-TT-64-1250/1; AD-617682)

Achievements in the field of physics are briefly reviewed, with particular emphasis on the phenomena of superconductivity and on cryogenics. The creation of a cryogenic laboratory is mentioned, and the importance of continued research on low temperature physics is pointed out. M.G.J.

N65-31876*# National Aeronautics and Space Administration, Washington, D. C.
THEORETICAL DERIVATION OF LAW OF SCINTILLATION DECAY IN THE CASE OF RESONANCE QUENCHING [O TEORETICHESKOM VYVODE ZAKONA ZATUKHANIYA LYUMINESTSENTSII PRI REZONANSNOM TUSHENII]
V. V. Antonov-Romanovskiy and M. D. Galanin Aug. 1965 5 p refs Transl. into ENGLISH from Opt. i Spektroskopiya (Moscow), v. 2, no. 3, 1957 p 389–391
(NASA-TT-F-8766) CFSTI: HC $1.00/MF $0.50 CSCL 20F

It was proposed that the quenching of the luminescence of a solution occurs as a result of the inductive-resonance transfer of the energy of excitation from excited molecules to unexcited ones. If the viscosity of the medium is sufficiently great in order to ignore the displacement of the molecules during the time of the excited state, a phenomenon occurs called impoverishment. In order to obtain the law of scintillation decay, a kinetic equation was written for the number of excited molecules. R.W.H.

N65-31902# Weapons Research Establishment (Australia).
A THEORETICAL AND EXPERIMENTAL STUDY OF THE PHOTOGRAPHIC IMAGES OF SINE WAVE OBJECTS
R. E. Little May 1965 57 p refs
(WRE-TN-ISD-60)

Two methods are established for predicting the amount of distortion associated with the recording of sine wave objects photographically. These methods are tested experimentally and graphs, which can be used to estimate the distortion when recording on the straight part of the H & D curve, are presented. A method for measuring the modulation transfer function of photographic emulsions is derived. This function is measured for four Ilford emulsions and the significance of the results is discussed. Author

N65-31933# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF THE INERTIA OF CARDAN SUSPENSION DISKS ON THE MOTION ON A GYROSCOPIC INTEGRATION OF LINEAR ACCELERATIONS
L. N. Slezkin 7 Jul. 1965 9 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekhan. i Mashinostr. (Moscow), no. 4, 1964 p 145–147
(FTD-TT-65-333/1+2+4; AD-618059)

The equations of motion of the heavy gyroscope in cardan suspension are considered and the dynamics of the gyro are discussed. Also, the relative error of the instrument is examined and a numerical example is given. E.E.B.

N65-31946# Technical Operations Research, Burlington, Mass.
A BASIC RESEARCH PROGRAM TO DETERMINE THE EFFECT OF MACROSCOPIC DENSITY VARIATIONS ON THE CORRELATION OF LIGHT PROPAGATING IN THE ATMOSPHERE
Thomas J. Skinner 28 Jul. 1964 7 p refs
(Contract DA-31-124-ARO(D)-133)
(AROD-4052-1; AD-460940)

A Born approximation to the solutions of the wave equations for the mutual coherence function has been explicitly evaluated for the case of an incoherent imaging system immersed in a Gaussianly correlated random atmosphere. It has been shown that this solution (the mutual coherence function after propagation through the atmosphere) can be used as a correction factor for the free space contrast transfer function of any imaging system to obtain the system performance in the presence of the atmosphere. In particular it has been shown that the correction factor is of the form a + b erf x/x, where a and b are constants and x is the separation in the entrance pupil. Author

N65-31955# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.
MEASUREMENT OF THE SPECTRAL DENSITIES OF TURBULENCE BY A METHOD DEDUCED FROM RICE'S FORMULAS [MESURE DE DENSITES SPECTRALES DE LA TURBULENCE PAR UNE METHODE DEDUITE DES FORMULES DE RICE]
Gabriel Coupry [1965] 8 p refs Presented at Symp. "Eng. Applications of Advanced Tech. of Random Process Analysis", Southampton, England, 5–9 Jul. 1965
(TP-243(1965))

Rice's formulas permit the prediction of the average number of zero-crossings per second of a Gaussian steady random process. Using a low-pass filter permits making the number of zero-crossings a function of the cut-off frequency. Thus we obtain a method of determination of the spectral densities free of the difficulties inherent to the use of selective filters and of a particularly easy utilization for the analysis of atmospheric turbulence. Author

N65-31961# Wisconsin Univ., Madison. Mathematics Research Center.
PROBABILITY AND QUANTUM MECHANICS
Stanley Gudder Mar. 1965 12 p refs
(Contract DA-11-022-ORD-2059)
(MRC-551; AD-614930)

This paper is mainly an expository note comparing the conventional probability theory of Kolmogorov with the propositional calculus of quantum mechanics. First an axiomatic formulation of the conventional probability theory is given. It is then shown that certain of these axioms are incompatible with quantum mechanical theory. These axioms are replaced by a weaker physically plausible axiom to obtain an axiomatic model for quantum mechanics. Also such physical concepts as observable, simultaneous verifiability and observability, the Heisenberg uncertainty principle, the Bohr correspondence principle, allowed values, and expectation values are discussed and simple mathematical prescriptions are given for their axiomatic counterparts. Author

N65-31989# Army Missile Command, Huntsville, Ala.
AZIMUTH AND ELEVATION ANGLES DERIVED FROM LINEAR MEASUREMENTS IN THE FOCAL PLANE
K. L. Hall and R. H. Farmer 1 Jul. 1964 14 p
(RE-TN-64-5; AD-460827)

An approximate equation is obtained for calculating the elevation angle by adding the angle and the vertical component of γ. The equation, $\beta\Omega' \approx \beta + \gamma\gamma$, is exact when the object is located on the vertical axis of the display; the error introduced is less than one percent when $\beta < 60°$ and $\gamma\gamma < 5°$. The incremental azimuth angle can be computed from an approximate equation, and an equation is given which results in slightly more than one percent error. If less error is required, the use of exact equations is recommended. Graphs are included for various errors and a typical observation geometry is illustrated. M.W.R.

N65-32161*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ENHANCEMENT OF PHOTOMULTIPLIER SENSITIVITY BY TOTAL INTERNAL REFLECTION
William D. Gunter, Jr., Edwin F. Erickson, and George R. Grant [1964] 6 p ref Submitted for Publication
(NASA-TM-X-54794) CFSTI: HC $1.00/MF $0.50 CSCL 20F

A good semitransparent photocathode should be very thin to permit escape of a large fraction of the electrons and sufficiently thick to absorb most of the incident light. These apparently contradictory requirements are examined to determine if these requirements can be harmonized without sacrificing the high electron collection efficiency of conventional end-window photomultiplier tubes. Although substantial increases in sensitivity are shown to be possible for existing type tubes, even greater increases may be possible by making special tubes with ultra-thin cathodes and using total internal reflection and multiple passes to maximize absorption of the light. E.E.B.

N65-32164*# Michigan Univ., Ann Arbor. Radiation Lab.
THE DYADIC GREEN'S FUNCTION FOR A MOVING ISOTROPIC MEDIUM
C. T. Tai [1964] 5 p refs Submitted for Publication
(Grant NsG-444)
(NASA-CR-59316) CFSTI: HC $1.00/MF $0.50 CSCL 20C

A derivation of the dyadic Green's function pertaining to simplified wave equations is presented without restriction upon the order of magnitude of the velocity. A compact result is obtained by transforming the wave equation into a conventional form, and equations are given for this as well as for the operational method used in the derivation. Results are summarized by a recapitulation of the successive steps with some simplification and rearrangement of terms. M.W.R.

N65-32172*# Stanford Research Inst., Menlo Park, Calif.
STUDY OF GROWTH PARAMETERS FOR REFRACTORY CARBIDE SINGLE CRYSTALS Quarterly Status Report No. 1, Mar. 1–Jun. 1, 1964
F. A. Halden 13 Jul. 1964 9 p refs
(Contract NASr-49(19); SRI Proj. PMU-4892)
(NASA-CR-56953) CSCL 20B

Suitable growth techniques and critical process parameters for preparing single crystals of refractory transition metal carbides are being investigated. A literature search was made to obtain pertinent information on the melting point as a function of stoichiometry, single-phase composition range, lattice parameters as a function of composition, gaseous equilibria at high temperatures, carbide solubility in liquid metals, and appropriate ceramic forming conditions. The rf plasma generator was modified to provide the operational stability required for crystal growth, and techniques to be used for solution growth are outlined. M.G.J.

N65-32180*# National Aeronautics and Space Administration, Washington, D. C.
THEORY OF QUENCHING THE FLUORESCENCE OF SOLUTIONS
I. M. Rozman Aug. 1965 11 p refs Transl. into ENGLISH from Opt. i Spektroskopiya (Moscow), v. 4, no. 4, 1958 p 536–538
(NASA-TT-F-8764) CFSTI: HC $1.00/MF $0.50 CSCL 20F

Formulas for the law of quenching and the quantum yield of fluorescence of organic substances are derived from a probability model. The model specifies a solution containing molecules of two substances: the molecules of the first substance are excited directly by an external source of radiation, and their energy of electron excitation can be transferred to the molecules of the second substance. It is assumed that return transfer is impossible, that the molecules are immobile during the time of the excited state, and that they are distributed statistically in the solution. J.M.D.

N65-32192*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
CALCULATIONS FOR MOSAICS WITH PLANE AND CURVED GRATING ELEMENTS Quarterly Progress Report No. 4
Philip C. Fisher 3 May 1965 6 p
(Contract NASw-917)
(NASA-CR-64435) CFSTI: HC $1.00/MF $0.50 CSCL 20F

A reexamination of grating mosaic calculations resulted in the adoption of a new terminology, whereby a quantity proportional to the resolution of the grating mosaic for a photon of energy E is used. This quantity is defined as $E/\Delta E$, when ΔE is the full width at half maximum on a plot of the number of photons in a given energy interval (which reach a given point in the image plane) versus energy. Figures which graphically depict the findings are included. M.G.J.

N65-32237# Tennessee Univ., Knoxville. Dept. of Physics.
LINE INTENSITY AND PRESSURE BROADENING STUDIES IN HYDROGEN FLUORIDE—AND OTHER PROBLEMS IN INFRARED SPECTROSCOPY Final Report, 1 Jan. 1961–31 Jan. 1965
Alvin H. Nielson, Robert J. Lovell, Norman M. Gailar, W. Edward Deeds, William F. Herget et al 31 Mar. 1965 24 p refs
(Contract AF 19(604)-7981)
(AFCRL-65-360; AD-618401)

Investigations were conducted to determine shapes, shifts, and self-broadening of lines in the fundamental band of HF. A vacuum grating spectrometer, resolving to 0.1 cm^{-1}, was used. Methods were developed to find true line profiles, correcting for effects of finite slits. Half widths and line strengths were measured. The pure rotational spectrum of HF, CO_2, T_2O, and CH_3Cl were also measured. Molecular constants are given. A theorem on the reduced matrix element of an irreducible spherical tensor was developed. In addition, a list of scientific reports and papers on various accomplishments of the current project, and a collection of reprints of published papers on the same subject are presented. R.N.A.

N65-32241# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPLICATION OF PROBABILITY METHOD FOR CALCULATION OF OPTICAL CHARACTERISTICS OF QUANTUM GENERATORS OF LIGHT
B. I. Stepanov and V. P. Gribkovskiy 26 May 1965 42 p refs Transl. into ENGLISH from Usp. Fiz. Nauk (Moscow), v. 82, no. 2, 1964 p 201–220
(FTD-MT-64-324; AD-618315)

The probability method introduced by Einstein in 1917 is used in calculating optical characteristics of three- and four-level quantum light generators. The operation modes of particular interest are steady-state pumping and generation without oscillations. In the calculations the energy levels and the probability of transition between them are used as initial data, and the main problem is reduced to determination of populations of separate levels depending on intensity of irradiation, and calculation of the number of optical transitions. J.M.D.

N65-32272*# National Aeronautics and Space Administration, Washington, D. C.
DELIBERATIONS ON OSCILLATING STRINGS [MEDITATIONES DE CHORDIS VIBRANTIBUS]
Johann Bernoulli [1964] 15 p Transl. into ENGLISH from Commentarii Academiae Scientiarum Imperialis Petropolitanae, v. 3, 1728 p 13–28
(NASA-TT-F-9515) CFSTI: HC $1.00/MF $0.50 CSCL 20

Deliberations on oscillating strings to which small weights are equidistantly attached, where, according to the principles of dynamics, the number of oscillations of the string is sought, expressed in terms of the number of oscillations of a pendulum of given length D. Author

N65-32279# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROBLEM OF SYNCHRONIZATION OF DYNAMIC SYSTEMS
I. I. Blekhman 1 Jun. 1965 46 p refs Transl. into ENGLISH from Prikl. Mat. i. Mekh. (Moscow), v. 28, Iss. 2, 1964 p 193–215
(FTD-MT-65-12; AD-618650)

It is noted that synchronization constitutes a phenomenon observed in the behavior of both artificially created and natural objects. A general formulation is made of the problem of synchronization of dynamic objects and its peculiarities are examined. The basic specific problems and applications are enumerated. Mathematical apparatus is indicated which is useful for studying a basic class of problems of synchronization, i.e., problems concerning the coordinated functioning of several almost identical self-oscillation objects weakly interacting with one another. The observed tendency of such objects of the most varied nature to synchronous movements finds its own mathematical expression in the fact that a defined system of differential equations with periodic coefficients, as a rule, allows stable periodic solutions. Author

N65-32388# Southampton Univ. (England). Inst. of Sound and Vibration Research.
INSTITUTE OF SOUND AND VIBRATION RESEARCH ANNUAL REPORT FOR THE YEAR ENDING JUNE 1965

[1965] 147 p refs

The organization, personnel, facilities, and activities of the Institute are summarized. Also, briefs are presented covering a wide spectrum of research on fundamental acoustics and aerodynamics, structures and vibrations, audiology, and industrial noise and instrumentation. Potentially one of the most significant developments was in the study of turbulent jets where measurements inside the potential core were identified with the near field of noise sources in the turbulent shear layer. Also, useful results were obtained in the field of fan noise with the study of rotor–stator interaction. New items are reported on the application of high-damping alloys to a range of general engineering vibration problems and the invention of a high-intensity random noise siren using a chain code. Further, a significant expansion has been made on the study of noise of internal combustion engines and automobiles. E.E.B.

N65-32390# United Kingdom Atomic Energy Authority, Harwell (England). Metallurgy Div.

X-RAY TOPOGRAPHY OF DECORATED DISLOCATIONS IN MAGNESIUM OXIDE

A. R. Lang and G. D. Miles May 1965 20 p refs

(AERE-R-4879)

Combined X-ray topographic and ultramicroscopic studies have shown a one-to-one correspondence between dislocation lines and chains of submicroscopic light-scattering bodies within a magnesium oxide crystal in the 'as received' state. All dislocations independent of their orientation and Burgers vectors were found to be decorated. The geometry and Burgers vectors of various unusual dislocation configurations have been determined. These special configurations all arose from the extension of edge segments in the course of intense dislocation climb combined with a strong preference for a line orientation parallel to a cube direction. The relationship of such configurations to the general distribution of dislocations showed that the epoch of intense dislocation climb had occurred late in the evolution of the dislocation distribution. X-ray diffraction evidence on whether the climb was due to the absorption of interstitials or of vacancies is as yet inconclusive. Author

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N65-31328# Instituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.

ELEMENTARY DISPERSION THEORY

I. M. Barbour 25 May 1964 37 p refs

(ISS-64/17)

Topics associated with dispersion theory are presented in an elementary manner. An intuitional rather than a rigorous mathematical approach is generally taken. Discussed are: (1) unitarity and the substitution rule; (2) singularities in perturbation theory; (3) the Mandelstam representation; (4) interpretation of the singularities; and (5) singularities of partial wave amplitudes. A general reaction involving four particles, and equations describing these reactions are given. Mandelstam's general substitution rule extended to physical amplitudes is discussed. This is used to derive dispersion relations in the energy variable at fixed momentum transfer as a function of two complex variables. Contributions from an arbitrary diagram using Feynman parameters, singularities, and thresholds are also considered. C.T.C.

N65-31329# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INSTRUMENTS AND METHODS OF RADIATION ANALYSIS Collection of Articles

Ye. L. Stolyarovoy, ed. 4 Mar. 1965 202 p refs Transl. into ENGLISH of "Pribory i Metody Analiza Izlucheniy" Moscow, Gos. Izd. Lit. v Oblasti Atom. Nauki i Tekhn., 1962 p 1-192 (FTD-MT-64-179; AD-617098)

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12. PHYSICAL BASES OF CREATION OF HIGH-EFFICIENCY DETECTORS OF FAST NEUTRONS G. G. Doroshenko and Ye. L. Stolyarova p 118–128 refs (See N65-31341 20-24)

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14. USE OF SPACE CHARGE AND GAS AMPLIFICATION IN A PHOTOMULTIPLIER FOR SEPARATION OF PULSES FROM FAST NEUTRONS AND GAMMA QUANTA G. G. Doroshenko and Ye. L. Stolyarova p 139–144 refs (See N65-31343 20-24)

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18. INSTALLATION FOR MEASUREMENT OF COMPLEX LOW-INTENSITY GAMMA SPECTRA Ye. L. Stolyarova, S. G. Chukhin, and A. V. Larichev p 186–191 refs (See N65-31347 20-24)

19. ON SENSITIVITY FUNCTION OF SCINTILLATION SPECTROMETER TO GAMMA RAYS WITH MAXIMUM ENERGY OF 5 MEV. A. V. Larichev, G. A. Cherevatenko, and V. V. Yakshin p 192–196 refs (See N65-31348 20-24)

N65-31331 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

RESEARCH IN SPECTRAL-ANGULAR DISTRIBUTIONS OF SCATTERED GAMMA RADIATIONS IN PROTECTIVE BARRIERS FOR THE CASE OF A TWO-DIMENSIONAL UNIDIRECTIONAL SOURCE

Ye. L. Stolyarova, S. G. Chukhin, I. Ye. Konstantinov, and A. I. Miskevich *In its* Instrs. and Methods of Radiation Analysis 4 Mar. 1965 p 15–38 refs (See N65-31329 20-24)

Angular energy distributions of Co^{60} gamma radiation scattered on the boundaries of aluminum, iron, or lead barriers of varying thicknesses were measured by total absorption gamma spectrometer. All angular energy distributions had a maximum corresponding to the energy of single scattering at a minimum angle, and were independent of the scattering angle, of the atomic number of the investigated medium, and of the thickness of the barrier. The peak of multiple scattering in regions of low energies depended on the medium's atomic number and shifted in the direction of higher energies with higher atomic numbers. The exponential dependence of the angular distribution of intensity depended on the exponential coefficient of the medium's atomic number. A comparison of the Al energy intensity spectra with theoretically found intensity values of scattered gamma radiation in an infinite water medium showed agreement in the hard part of the spectrum. G.G.

N65-31332 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ANGULAR AND ENERGY DISTRIBUTIONS OF GAMMA RAYS Co^{60}, SCATTERED IN A HETEROGENEOUS MEDIUM OF Al + Pb

A. V. Larichev and L. F. Klimanov *In its* Instrs. and Methods of Radiation Analysis 4 Mar. 1965 p 39–47 refs (See N65-31329 20-24)

A single crystal NaI (Tl) gamma spectrometer with strong collimation was used to measure the distribution of scattered gamma-radiation from a two-dimensional undirected Co^{60} source after radiation passed through two-layer Pb and Al barriers of various thicknesses. It was found that the maximum scattered radiation at a given angle corresponded with the energy value of single scattered radiation for the same angle, and that the exponential dependence of scattered radiation intensity for a given angle was independent from the location of the layers. Quantitative differences in the intensity values depended mainly on the location of layers. Experimental results and calculations for radiation scattering from pure lead, and from aluminum and lead combination layers showed good agreement. Experimental scattering data for the lead and aluminum combination were higher than calculated values. G.G.

N65-31333 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

RESEARCH ON SENSITIVITY SINGLE-CRYSTAL SCINTILLATION GAMMA SPECTROMETER WITH A CRYSTAL OF NaI (Tl) 80 × 80 mm

A. V. Larychev and G. A. Cherevatenko *In its* Instrs. and Methods of Radiation Analysis 4 Mar. 1965 p 48–53 refs (See N65-31329 20-24)

The instrument sensitivity of a scintillating spectrometer with a cylindrical crystal of NaI (Tl) was investigated by measurements of gamma spectra from the following isotopes: Hg^{203}, Au^{198}, Cs^{137}, Zn^{65}, and Na^{24}. The pulse height distributions of each spectral component to the observed output amplitudes were defined and connected with the true spectrum of gamma rays by the Fredholm integral equation. A numerical matrix of Compton scattering contributions was built by interpolation of experimental spectra from gamma lines 279, 411, 661, and 1120 keV. The total continuum from isotope Co^{60} gamma rays at 1170 and 1330 keV was obtained by matrix, and the complete instrument spectrum of isotope Co^{60} gamma rays at those energies is shown graphically. G.G.

N65-31334 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DEPENDENCE OF BUILT-UP FACTORS ON LOCATION OF PROTECTIVE BARRIER BETWEEN SOURCE AND DETECTOR

D. P. Osanov *In its* Instrs. and Methods of Radiation Analysis 4 Mar. 1965 p 54–62 refs (See N65-31329 20-24)

The dependence of the gamma radiation dose build-up factors on the location of the protective barrier was studied for the case that: (1) the source of gamma radiation is a monoenergetic point; (2) the surface of the protective barrier is infinite; (3) the single scattering of gamma rays in shielding is considered; and (4) the source, detector, and shielding are in a vacuum. A differential expression valid for any location of the protective barrier between the source and the detector was formed. This gives the dose rate behind the shield from a pointed beam of radiation which hits the shield at a certain angle and experiences single scattering in the shield angle. It was found that the magnitude of the barrier build-up factor from double scattered and subsequent components increased with the thickness of the shield and its closeness to the source. G.G.

N65-31337 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CALCULATION OF GRAPHITE IONIZATION CHAMBER FOR MEASUREMENT OF INTENSITY OF BREMSSTRAHLUNG IN RANGE OF ENERGIES FROM 1 TO 100 MEV

G. A. Cherevatenko and V. F. Frolov *In its* Instrs. and Methods of Radiation Analysis 4 Mar. 1965 p 81–90 refs (See N65-31329 20-24)

The sensitivity of a thick-walled ionization chamber with graphite walls to energy quanta from 1 to 100 MeV was calculated. The Compton scattering of the energies and the effect of steam formation at the wall of the chamber were considered. The construction of a thick-walled ionization chamber to measure direct flux intensities of gamma quanta up to 100 MeV was considered possible within an accuracy of ±10%, since similar calculations for the involved secondary processes did not exceed a 5% correction. G.G.

N65-31339 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

MEASUREMENT OF DOSES OF FAST NEUTRONS (SHORT SURVEY)

O. I. Leipunskiy *In its* Instrs. and Methods of Radiation Analysis 4 Mar. 1965 p 99–107 refs (See N65-31329 20-24)

Discussed are dosimetric equipment and methods to measure neutrons of the intermediate energy rate from 0.4 to 1 MeV. Proposed is a stationary or personal dosimeter consisting of a paraffin block which incorporates an indicator of thermal neutrons at a definite depth. Such indicators can be foils, boron chambers, scintillators with boron, etc. A quantitative appraisal of the intermediate energy neutron contribution to a complete dose of neutrons depends on the spectrum of these neutrons in practical conditions, and the determination of their differences from the Fermi spectrum. G.G.

N65-31340 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THRESHOLD DETECTORS FOR MEASUREMENT OF FLUXES AND SPECTRA OF FAST NEUTRONS

V. P. Mashkovich *In its* Instrs. and Methods of Radiation Analysis 4 Mar. 1965 p 108–117 refs (See N65-31329 20-24)

Detectors, sensitive to the threshold reactions (n,a), (n,p), and (n,2n), are discussed, and their applications for measuring the isotope decay curves of fast neutron fluxes and spectra are described. Various threshold indicators were investigated, and the basic characteristics of magnesium, aluminum, iron, nickel, copper, phosphor, and sulfur detectors are shown. Total fast neutron flux measurements from the reaction $P^{31}(n,p)Si^{31}$ by sulfur and phosphorus indicators were compared with the spectrum of fast-neutron flux calculated by the method of moments for a point isotropic source in water shielding; an accuracy of ~ 20 to 30 percent was found. G.G.

N65-31341 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PHYSICAL BASES OF CREATION OF HIGH-EFFICIENCY DETECTORS OF FAST NEUTRONS

G. G. Doroshenko and Ye. L. Stolyarova *In its* Instrs. and Methods of Radiation Analysis 4 Mar. 1965 p 118–128 refs (See N65-31329 20-24)

A series of separating devices for cutoff of gamma background in high efficiency detectors of fast neutrons was classified by principles and methods of operation. The various de-excitation characteristics of organic scintillators are presented in tables showing their exponential components for a fast, nano-second mode giving ~ 80 percent of total light output, and for one or several slow modes with de-excitation times from 0.1 to 100 microseconds. The methods of separation of the pulses are listed. G.G.

N65-31342 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CUTOFF OF GAMMA BACKGROUND IN HIGH-EFFICIENCY DETECTOR OF FAST NEUTRONS WITH HELP OF SPACE CHARGE IN A PHOTOMULTIPLIER

G. G. Doroshenko and Ye. L. Stolyarova *In its* Instrs. and Methods of Radiation Analysis 4 Mar. 1965 p 129–138 refs (See N65-31329 20-24)

The maximum energies of secondary electrons were determined for a NaI (Tl) crystal, and for the organic scintillators anthracene, stilbene, tolane, and naphthalene. This was done by conversion of the difference in effective de-excitation into a difference in amplitude at the output of a photomultiplier. The photomultiplier worked in conditions of deep saturation by a space charge, and the magnitude of the saturation amplitude was determined by the de-excitation time. The following effective de-excitation times were obtained: stilbene (electron excitation ~ 13 nsec, proton excitation ~ 26 nsec); anthracene (proton excitation ~ 50 nsec; and naphthalene ~ 115 nsec. Comparison of amplitude distributions for various pure gamma radiators showed that increased voltage on the photomultiplier, and propagation of saturation in the lower energy values of secondary electrons increased the relative number of pulses from recoil protons with amplitudes exceeding the plateau of electron excitation. G.G.

N65-31343 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

USE OF SPACE CHARGE AND GAS AMPLIFICATION IN A PHOTOMULTIPLIER FOR SEPARATION OF PULSES FROM FAST NEUTRONS AND GAMMA QUANTA

G. G. Doroshenko and Ye. L. Stolyarova *In its* Instrs. and Methods of Radiation Analysis 4 Mar. 1965 p 139–144 refs (See N65-31329 20-24)

The ratio of amplitudes of saturation for recoil protons and Compton recoil electrons was investigated for the operating mode of the last three cascades of a photomultiplier. Different values of load resistance in the circuit of the 13th dynode were used. A load value of 200 kilohms and a decrease of the potential difference between the 12th and the 13th dynodes increased the amplitude ratio substantially. This phenomenon is attributed to the drop in pulse time voltage which in turn creates a condition for catching positive ions of residual gas in the formed potential trap. The focusing action of the motionless positive ions in the interval between dynodes, and the added partial compensation of the electron space charge lead to the increase of output amplitude. It was concluded that all photomultipliers which work well in the regime of space charge also work well in the regime of gas amplification. G.G.

N65-31346 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SCINTILLATION COUNTER OF ULTRAFAST NUCLEONS

V. N. Lebedev and M. I. Salatskaya *In its* Instrs. and Methods of Radiation Analysis 4 Mar. 1965 p 169–185 refs (See N65-31329 20-24)

Described is a stable counter of ultrafast neutrons with a low energy threshold of 20.6 MeV. Activated liquid scintillators of a p-terphenyl base containing carbon were used to register scintillations from C^{11} decay positrons against a large background of gamma radiation. Experiments with a solution of p-terphenyl in toluene activated jointly with carbonic cylinders in a neutron beam of a synchrocyclotron, were used to determine the neutron flux level. The efficiency of the positron decay rate counter was found to be constant within ±5 percent for many hours duration. The counter had the following parameters: (1) a 1000 ml volume scintillator; (2) a resolving time for coincidence selection of about 10^{-8} sec; (3) a coincidence selection unit sensitivity of 0.2 v; (4) a positron registration efficiency of 51%; (5) an average background counting rate of 6.3 sec^{-1} with scintillator, and of 0.1 sec^{-1} without scintillator; and (6) a 30 minute period for establishment of the rated regime after switching on. G.G.

N65-31347 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INSTALLATION FOR MEASUREMENT OF COMPLEX LOW-INTENSITY GAMMA SPECTRA

Ye. L. Stolyarova, S. G. Chukhin, and A. V. Larichev *In its* Instrs. and Methods of Radiation Analysis 4 Mar. 1965 p 186–191 refs (See N65-31329 20-24)

Preparation and assembly of a single-crystal scintillation spectrometer for observation of gamma ray penetration are described, and a block diagram of the apparatus is shown. The unit encompasses a NAI (Tl) crystal and a photomultiplier that is controlled by a voltage feeding divider to insure good energy resolution selection. This device obtained an energy resolution of 9.5 percent for gamma rays of Cs^{137}, and has an energy instability of not more than 1.5 to 2 percent. G.G.

N65-31348 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON SENSITIVITY FUNCTION OF SCINTILLATION SPECTROMETER TO GAMMA RAYS WITH MAXIMUM ENERGY OF 5 MEV

A. V. Larichev, G. A. Cherevatenko, and V. V. Vakshin *In its* Instrs. and Methods of Radiation Analysis 4 Mar. 1965 p 192-196 refs (See N65-31329 20-24)

The entire sensitivity function of a scintillation spectrometer with an 80 × 80 mm NaI (Tl) crystal was studied for the following sources of gamma rays: Hg^{203}, Au^{198}, Cs^{137}, Zn^{65}, Na^{24}, and a Po + Be source (4.45 MeV). The dependency of the photoefficiency and the photocontribution on the energy of the gamma rays is shown, and a matrix of Compton contributions for gamma rays with a maximum energy of 5 MeV was obtained. Direct and inverse matrices were constructed of the sensitivity function and served for analysis of the instrument spectra. Good conformity of the obtained photon and instrument spectra was found. G.G.

N65-31403# Los Alamos Scientific Lab., N. Mex.

THE APPROXIMATE DOPPLER BROADENING OF AN ISOLATED NUCLEAR RESONANCE

Joseph J. Devaney 11 Aug. 1965 41 p refs

(Contract W-7405-ENG-36)

(LA-3315) CFSTI: $2.00

Approximate formules are presented for calculating the Doppler broadening of narrow isolated nuclear resonance cross sections of an isotope. The source of the approximation formulas is outlined; and the properties, convenience of use, and accuracy of the four presented formulas are stated. The approximation formulas are concluded to be either too inaccurate or too tedious to merit preference over tables or machine calculation. R.N.A.

N65-31450# Maryland Univ., College Park. Dept. of Physics and Astronomy.

PROCEEDINGS OF THE THIRD ANNUAL EASTERN UNITED STATES THEORETICAL PHYSICS CONFERENCE

E. J. Woods, ed. [1964] 343 p refs Conf. held at Maryland Univ., 30-31 Oct. 1964; sponsored by NSF

Theoretical studies of quantum fields and mechanics, superconductivity, magnetism, elementary particles, gravitation, and symmetry groups are reported. For individual titles see N65-31451—N65-31475.

N65-31453 Catholic Univ. of America, Washington, D. C.

LOW TEMPERATURE EXPANSION OF THE SPONTANEOUS MAGNETIZATION OF A HEISENBERG FERROMAGNET

Tohru Morita and Tomoyasu Tanaka *In* Maryland Univ. Proc. of the 3d Ann. Eastern U.S. Theoret. Phys. Conf. [1964] 7 p refs (See N65-31450 20-24)

(Grant AF-AFOSR-445-63)

It has been shown that the distribution function of quasiparticles is generally given by a Bose or Fermi formula with a specified effective energy and with the assumption that the eigenstate of the system is described by specific sets of occupation numbers. Formulas for eigenvalue and effective energy in the distribution are given. From these results spontaneous magnetization can be calculated. The possibility of low-lying n-spin wave bound state is neglected in these results. The eigenvalue problem was solved for the simple cubic, face-centered cubic, and body-centered cubic lattices, assuming that the exchange integral is non-zero between nearest neighbors along axis, face diagonals, and body diagonals. M.W.R.

N65-31455 Catholic Univ. of America, Washington, D. C. Dept. of Physics.

COLLECTIVE NUCLEAR VIBRATIONS INDUCED BY HIGH ENERGY NEUTRINOS

H. Uberall *In* Maryland Univ. Proc of the 3d Ann. Eastern U.S. Theoret. Phys. Conf. [1964] 5 p refs (See N65-31450 20-24)

Transition probability and lepton angular distribution in excitation of nuclear giant dipole states are evaluated with a Goldhaber-Teller model of the giant dipole resonance and its spin-isobaric spin generalization. The reaction and its charge conjugate have a matrix element squared and summed over lepton spins given in first order by an equation accounting for neutrino and lepton momentum, excitation energy, and beta decay coupling. Assuming charge independence, expressions for the vector and axial vector matrix elements are given. Goldhaber-Teller oscillations of the proton against the neutron Fermi sphere are described by a nuclear transition density matrix. A total cross section rising steeply from the threshold and a leveling off is found; this plateau is caused by the two form factors and represents 5% of the cross section for the elastic reduction. This reaction is experimentally distinguishable from the reaction in the first order mentioned above. M.W.R.

N65-31456 State Univ. of New York at Buffalo.

REMOVAL OF ACCIDENTAL DEGENERACY BY A MODIFIED CRYSTAL FIELD THEORY

H. Goldberg *In* Maryland Univ. Proc. of the 3d Ann. Eastern U.S. Theoret. Phys. Conf. [1964] 15 p refs (See N65-31450 20-24)

(Grant NSF G-18466)

Most of the accidental degeneracy is removed by a modified crystal field theory which considers wave function overlap and electron exchange of perturbed ions, specifically p^n electronic configuration atoms perturbed by the field of a neighboring hydrogen molecule in its ground state. Accidental degeneracy is removed the the modified treatment, referred to as the Expanded Hamiltonian-Separated Atom-Molecular Orbit method, when the molecule and atom nuclei form a collinear system; most of the degeneracy is removed when the atom and nuclei are arranged so that the interaction Hamiltonian has a C_{2v} symmetry. In the latter case, conventional crystal field theory predicts five-fold degeneracy, whereas the present theory predicts four levels, one of which is doubly degenerate. The presence of spin in the wave functions is observed to be the cause of this. It is further stated that there can be no exchange or wave function overlap between orbitals having different spins, which makes the five-spin orbitals divide into two groups so that the spin up and down functions are orthogonal to each other. M.W.R.

N65-31457 North Carolina Univ., Chapel Hill.

GRAVITATION AND QUANTUM MECHANICS OF MACROSCOPIC OBJECTS

Frederick Karolyhazy *In* Maryland Univ. Proc. of the 3d Ann. Eastern U.S. Theoret. Phys. Conf. [1964] 19 p refs (See N65-31450 20-24)

(Grant AF-AFOSR-153-63)

Smearing in spacetime is expressed quantitatively and built into an equation for the propagation of wave amplitudes; and this small smearing reveals the relationship between macroscopic bodies and macroscopic spacetime to be consistent. In order to formalize the necessary equation, a coordinate system in a flat space is imagined and an attempt is made to materialize a segment of the t-axis by the best narrow tube formed by a standing wave pocket. Minimum uncertainity is found to diminish with increasing mass. The equation is actually derived from basic concepts in quantum physics and gravitation. M.W.R.

N65-31458 Boston Univ., Mass. Dept. of Physics.
THE MASSES OF ELEMENTARY PARTICLES FROM THE GEOMETRY OF SPACE-TIME
Mendel Sachs *In* Maryland Univ. Proc. of the 3d Ann. Eastern U.S. Theoret. Phys. Conf. [1964] 16 p refs (See N65-31450 20-24)
(Contract AF 19(628)-2816)

A set of interdependent field equations which express the combined gravitational, electromagnetic, and inertial manifestations of interacting particles can be obtained by a unified field approach to interaction theory. A discussion is included of the current stage of development of unified field equations which are expressed in terms of a common mathematical basis of quaternion and spinor field variables. These fields do not relate to the intrinsic features of free particles; instead the inertial mass relates to the field properties of the space-time coordinate system which is dependent on the interaction between all the components of the system. This analysis, which agrees with the role of mass from the Mach principle, permits the establishment of a one-to-one correspondence between observed mass spectrum of elementary particles and field solutions that relate to the coordinate space. A computation of the rest mass of the neutrino and its possible relationship to recent neutrino experiments is considered. M.W.R.

N65-31459 Georgia Inst. of Tech., Atlanta.
STIMULATED PHOTON-PHOTON SCATTERING
I. R. Gatland, L. Gold (Martin Co., Baltimore), and J. W. Moffat (Toronto Univ.) *In* Maryland Univ. Proc. of the 3d Ann. Eastern U.S. Theoret. Phys. Conf. [1964] 8 p refs (See N65-31450 20-24) Prepared jointly with Martin Co., Baltimore and Toronto Univ.

If a stimulating beam of photons is superimposed on the direct nonlinear interaction region, the resulting stimulated photon-photon scattering could be observed with foreseeable laser power. In the proposed experiment, one laser beam is reflected back by a mirror and the other is scattered at an angle equal to the incident angle θ which satisfies Bragg's Law, $\lambda_0 = \lambda \sin \theta$, where λ_0 and λ are the wavelengths of the incident and standing wave beams, respectively. This geometry corresponds to a so-called "brick wall" coordinate system, and the probable number of stimulated scattering events per second could be obtained. Such results indicate that it may be possible to observe stimulated photon-photon scattering in a vacuum; the main problem being the separation of the scattered photons from the Rayleigh scattering background caused by the scattering of light by atoms in the vacuum. M.W.R.

N65-31460 Air Force Cambridge Research Labs., Bedford, Mass. Office of Aerospace Research.
QUANTUM MECHANICAL THREE-BODY PROBLEM FOR ATTRACTIVE POTENTIALS
Leonard Eyges *In* Maryland Univ. Proc. of the 3d Ann. Eastern U.S. Theoret. Phys. Conf. [1964] 32 p refs (See N65-31450 20-24)

A set of two-body functions, which are the eigenfunctions of enhanced strength of a two-body problem with a potential of the same shape as the interparticle potential in a three-body problem, is given for the quantum mechanical problem of finding the ground state energy and eigenfunctions. The resulting integral equation becomes a set of coupled equations which, by optimizing convergence of expansion, becomes a single integral equation which can be solved by an approximate method. These results are then applied to δ-function potentials in one dimension, and a comparison is made with exact solutions. Application is then made to the three-body three-dimensional problem with exponential interparticle potentials, and the results are compared with variational characteristics. The method outline is considered applicable in any interparticle potential of finite range and with four- and N-body problems. M.W.R.

N65-31461 Institute for Advanced Study, Princeton, N. J.
SPIN AND UNITARY SPIN INDEPENDENCE IN A PARA-QUARK MODEL OF BARYONS AND MESONS
O. W. Greenberg *In* Maryland Univ. Proc. of the 3d Ann. Eastern U.S. Theoret. Phys. Conf. [1964] 12 p refs (See N65-31450 20-24) Submitted for Publication

A basic atomic paraquark model is used in which all the baryons and mesons are composite objects made up of basic particles. The basic forces are assumed to be independent of unitary spin, but in general spin-dependent; and the approximate symmetry group of the theory is $\overline{P} \times SU(3)$, with $\overline{P}$ the covering Poincaré group. Additional degeneracy for low-lying bound states allows for SU(6) invariance if the vector spin-spin forces are not too large. A formula is given for the one-body force for the mass operator. Three spin one-half quarks are then placed in the S-states in the baryon 56. A brief defense is offered for the possibility that quarks are parafermi, and a classification is made of the baryon states in the paraquark model. M.W.R.

N65-31462 Maryland Univ., College Park.
DEPARTURES FROM THE EIGHTFOLD WAY
S. Coleman *In its* Proc. of the 3d Ann. Eastern U.S. Theoret. Phys. Conf. [1964] 19 p (See N65-31450 20-24)

Medium-strong interactions, a recently-discovered connection between medium-strong and electromagnetic reactions, and weak interactions are discussed. Octet dominance, a property of very strong interactions that causes them to enhance the octet part of electromagnetic mass splitting, is considered. Three types of models are mentioned: a tadpole model assumes the existence of an octet of scalar mesons; a mixing model assumes that medium-strong mass splittings are dominated by diagrams that involve the mixing of a singlet and an octet vector meson; and bootstrap models are based on spontaneous symmetry breakdown. Some of these models have been shown to display universal octet dominance, non-degeneracy, or a theory of next corrections. The tadpole model, for which next corrections were made, is the easiest to work with and is recommended for calculating hadron electromagnetic mass differences; the mixing models have the advantage of a self-consistent check; and the bootstraps require the most complicated calculations. M.W.R.

N65-31463 Virginia Univ., Charlottesville. Dept. of Physics.
ON THE PROBLEM OF COMBINING INTERNAL AND SPACE-TIME SYMMETRIES
Jan Nilsson *In* Maryland Univ. Proc. of the 3d Ann. Eastern U.S. Theoret. Phys. Conf. [1964] 26 p refs (See N65-31450 20-24)

Restrictions on the fundamental symmetry group G are related to the problem of combining internal and space-time symmetries in order to derive additional and more detailed criteria for study of the symmetry group S. Several theorems on Lie groups are stated, compact Lie groups are considered, and the coupling between the internal symmetry group and the Poincaré group is described. The possibility of coupling the internal degrees of freedom for elementary particles with the space-time properties was obtained by accepting nonhermitian operators for energy, momentum, and angular momentum. Choice of internal symmetry groups is limited to those which will yield multiplets including particles of different charge but with the same baryon and lepton numbers. Study of the SU(6) group is considered within the framework of the suggestions offered. M.W.R.

N65-31464 Brookhaven National Lab., Upton, N. Y.
REPORT ON SOME RECENT WORK ON HIGHER SYMMETRIES
L. A. Radicati *In* Maryland Univ. Proc. of the 3d Ann. Eastern U.S. Theoret. Phys. Conf. [1964] 19 p refs (See N65-31450 20-24)

Symmetrical features of composite models and the properties of the currents responsible for weak interactions suggest the consideration of symmetries higher than SU(3). Symmetry groups SU(4) and Sp(6) are discussed and, in both cases, all the known particles and resonances are assumed to be composite structures of fundamental particles which transform under SU(3) like the one- and three-dimensional representations. Features of both symmetries are considered; it is felt that the discovery of two kinds of massive particles with integer charges and half-integer spins will strengthen belief in one or the other of these groups. Schwinger's field theoretical model, based on the analogy between electric and nucleonic charge, provides a very natural mechanism for the violation of SU(3); and gives an explanation for the relation between vector and pseudoscalar masses and for different behavior of the phi-meson. The symmetry group of vector and axial vector currents is considered and a supermultiplet scheme is presented. M.W.R.

N65-31465 Purdue Univ., Lafayette, Ind.
SU(6) AND NONLEPTONIC HYPERON DECAY
S. P. Rosen *In* Maryland Univ. Proc. of the 3d Ann. Eastern U.S. Theoret. Phys. Conf. [1964] 7 p refs (See N65-31450 20-24)

Consideration is given to how a subgroup of SU(6) can accommodate nonleptonic hyperon decay. It is assumed that nonleptonic decays transform according to the 35 representation of SU(6); and the number of independent ways of forming a 35 representation from baryon, anti-baryon, and meson triplets is determined. This is accomplished by decomposing a 56 × 56 into an irreducible representation and then combining these results with 35 to form an overall 35 representation. It is shown that the assignment of the nonleptonic decay Hamiltonian to the 35 representation of SU(6) is not in good agreement with experiment, and that the 35 is not adequate for leptonic decay. Further studies might concern themselves with the 405 representation which appears four times in the 56 × 56 × 35 representation. M.W.R.

N65-31466 South Carolina Univ., Columbia. Dept. of Physics and Astronomy.
REPRESENTATION OF DISCRETE SYMMETRY OPERATORS
K. H. Mariwalla *In* Maryland Univ. Proc. of the 3d Ann. Eastern U.S. Theoret. Phys. Conf. [1964] 32 p refs (See N65-31450 20-24)

Representation of discrete symmetry operators connected to space, time, and generalized charge are considered. Discussed are the cases of operators in nonrelativistic quantum mechanics as well as in relativistic quantum theory of free fields in terms of field operators rather than the positive and negative frequency parts. An algebraic method, developed for expressing the latter as a relationship between the generators and the appropriate observables, is found to be isomorphic to the Lie algebra of generators of rotation in an n-dimensional Euclidean space. Since the symmetry operators commute apart from a phase factor, it is possible to factor a symmetry operator into a factor that corresponds to a phase transformation and into another factor that is responsible for the discrete change. The second part of the phase transformation, which considers effects on one-particle states, is the only part of the method which brings in considerations from field theory. A table defines discrete symmetry operators in terms of effect on coordinates, charge, linear momentum, and angular momentum. M.W.R.

N65-31467 Columbia Univ., New York. Dept. of Physics.
WEAK INTERACTIONS
G. Feinberg *In* Maryland Univ. Proc. of the 3d Ann. Eastern U.S. Theoret. Phys. Conf. [1964] 11 p refs (See N65-31450 20-24)

Possible explanations are considered for an apparent violation of CP invariance in neutral K meson decay in weak interactions. Both the initial and final states of the interactions are discussed, and a general classification of possible explanations is included with CP invariance maintained. Theoretical possibilities are reviewed for the case when CP is not conserved, and it is suggested that a new interaction, rather than just a coda to the ordinary weak interaction, is taking place. M.W.R.

N65-31468 Cornell Univ., Ithaca, N. Y.
EXTRAPOLATION OF NUCLEON ELECTROMAGNETIC FORM FACTORS
C. P. Wang (Catholic Univ. of America) and J. S. Levinger (Rensselaer Polytech. Inst.) *In* Maryland Univ. Proc. of the 3d Ann. Eastern U.S. Theoret. Phys. Conf. [1964] 16 p refs (See N65-31450 20-24)

A conformal transformation is used to aid in extrapolation from space-like to time-like momentum transfer. Nucleon spectral function is thus found for the isovector magnetic nucleon, with a peak at 622 MeV. The electric form factor which is below the resonance energy of 750 MeV. The electric form factor for elastic electron-deuteron scattering is analyzed in terms of the difference between measured and calculated values; extrapolation of this difference results in values for the electric isoscalar form factor which are statistically consistent for space-like momentum transfer. Here, the spectral function has a narrow peak at 688 MeV and a dip around 1150 MeV. Input data for electron–nucleon scattering and elastic electron–deuteron scattering are tabulated. Spectral functions are presented in tabular and diagrammatic forms. M.W.R.

N65-31469 Carnegie Inst. of Tech., Pittsburgh, Pa.
A BIRDS-EYE VIEW OF S-MATRIX THEORY
R. E. Cutkosky *In* Maryland Univ. Proc. of the 3d Ann. Eastern U.S. Theoret. Phys. Conf. [1964] 16 p refs (See N65-31450 20-24)
(CAR-882-1)

A classification of the various aspects of S-matrix theory is divided into *descriptive*, related to theorem proving, and *constructive*, related more directly to interpretation of experimental data. Within these categories, which were made to show the variety in S-matrix work, distinction is made between formal and empirical approaches. The formal-descriptive category could use methods in axiomatic field theory, potential scattering, and perturbation expansions for studies dealing with analyticity, singularity structure, and asymptotic behavior. Formal-constructive could deal with approximation methods, axiomatic conjecture, and inversion. The empirical-descriptive category might consider parametrization and correlation of data and verification of principles; empirical-constructive studies might deal with dynamical models, compositeness, or uniqueness. Bootstrap dynamics are discussed in terms of compositeness; several difference views are presented with regard to bootstrap uniqueness; and equations are presented to define bootstrap algebras. M.W.R.

N65-31470 Rutgers Univ., New Brunswick, N. J. Dept. of Physics.
ON THE EXISTENCE OF SOLUTIONS TO THE FIELD EQUATIONS

J. G. Taylor *In* Maryland Univ. Proc. of the 3d Ann. Eastern U.S. Theoret. Phys. Conf. [1964] 9 p refs (See N65-31450 20-24)

An integral set of coupled nonlinear equations which arise from local Lagrangians for quantized fields is considered. Two problems arise: one deals with the existence of a solution and its uniqueness to the field equations; the other concerns itself with numerical solutions. The mathematical difficulties encountered in the first problem are tabulated, and methods of avoiding each difficulty are discussed. M.W.R.

N65-31471 Brown Univ., Providence, R. I.
VARIANTS OF CANONICAL FORMALISM
Elihu Lubkin *In* Maryland Univ. Proc. of the 3d Ann. Eastern U.S. Theoret. Phys. Conf. [1964] 3 p refs (See N65-31450 20-24) Sponsored by AEC

Canonical formalism is regarded as defining a large but proper subgroup of the group of all possible motions in real n-dimensional space, n-finite. The study is limited to Lie algebras of possibly infinite dimension. Ordinary canonical formalism is obtained by preserving a non-singular alternating 2-form of null exterior derivative, and a result is given to show, in part, why this derivative condition is present. M.W.R.

N65-31472 Pittsburgh Univ., Pa.
SU_6 IN RELATIVISTIC PARTICLE MECHANICS
B. Schroer *In* Maryland Univ. Proc. of the 3d Ann. Eastern U.S. Theoret. Phys. Conf. [1964] 6 p refs (See N65-31450 20-24)

The relativistic invariant framework which was used to formulate SU(6) independence is, as long as particle number is restricted, considered very different from field theory. This framework is much closer to S-matrix theory, and for nonlocal expressions in the various channel-mass operators there is an ample supply of unitary S-matrices. Crossing symmetry and bootstraps can be introduced as long as they are not self-contradicting within an approximation which limits the number of particles. A Hamiltonian with a free and an interacting part is considered; when the term is rewritten into canonical quantities, the permutation invariance of spin and internal symmetry indices of the free Hamiltonian are lost. A system of two spin 1/2 particles is also considered; and the restrictions on the mass operator which will insure the existence of a unitary Lorentz invariant and macrocausal SU(6) independent S-matrix are fall-off properties which are trivial. Restrictions are less trivial in a construction for three particles. M.W.R.

N65-31473 Princeton Univ., N. J.
SOME GENERAL REMARKS ON THE STATE OF AXIOMATIC FIELD THEORY
A. S. Wightman *In* Maryland Univ. Proc. of the 3d Ann. Eastern U.S. Theoret. Phys. Conf. [1964] 13 p refs (See N65-31450 20-24)

Four approaches are presented to relativistic quantum theory of matter, and it is concluded that all the known explicitly soluble models yield fields which are essentially functions of free fields. Special properties of two-dimensional space-time, which are required for explicit solubility of two-dimensional models and the techniques required to display solutions, are stated. These include: the equivalence or Borchers field of a free field is richer in two-dimensional than in higher dimension space-time; there is no mass-zero scalar field; a free mass-zero two-component spinor field is well defined; and the divergence of the vector field is equal to the curl of the dual vector. With these properties considered, comments are offered on the four quantum theory approaches and the ways in which to deal with the specific properties of two-dimensional space-time. M.W.R.

N65-31474 Institute for Advanced Study, Princeton, N. J.
ON THE PROOF OF THE LSZ ASYMPTOTIC CONDITION
Klaus Hepp *In* Maryland Univ. Proc. of the 3d Ann. Eastern U.S. Theoret. Phys. Conf. [1964] 10 p refs (See N65-31450 20-24)

A B-theory of local Lorentz invariant fields, which are operator-valued tempered distributions in a Hilbert space, is considered. It is assumed that energy spectrum is bounded from below with a non-degenerate vacuum; and at least a single one-particle state can be generated by the smeared-out fields from the vacuum to all discrete irreducible representations of the Lorentzian. Two possibilities are considered for constructing the asymptotic observables, and it is shown that the LSZ asymptotic condition can be derived on a dense set of asymptotic states. Reduction formulas for the scattering amplitudes and the behavior of time-ordered products near the mass shell are discussed. Non-overlapping is considered in three theorems, and some of the results are generalized to arbitrary spins and bound states. These results shed some light on possible unification of A- and B-theories. M.W.R.

N65-31475 George Washington Univ., Washington, D. C.
FOLDY-WOUTHUYSEN TRANSFORMATION IN COVARIANT SPINOR FORMULATION
Herbert Jehle and William C. Parke *In* Maryland Univ. Proc. of the 3d Ann. Eastern U.S. Theoret. Phys. Conf. [1964] 6 p refs (See N65-31450 20-24)

The transformation which splits the four-component Dirac equation for the free particle into a pair of two-component equations and can be related to a pair of Lorentz transformations is considered in the framework of covariant spinor formalism. Plane wave solutions of the Dirac equation are considered, and both positive and negative energy contributions of the pair of two-component equations are taken into account. Transformations are given for both primed and unprimed reference systems, and each of these leads to a complete set of functions of a given momentum. These reference systems may be mapped into one coordinate system. M.W.R.

N65-31500# California Univ., Berkeley. Dept. of Physics.
THE GREEN'S FUNCTION METHOD AND SUPERCONDUCTIVITY OF SYSTEMS OF FERMIONS
Jerzy Sawicki [1961] 27 p refs
(Contract AF 49(638)-327)
(AFOSR-245; AD-255778)

The method of Green's functions in the theory of many fermion systems has been recently developed by Gorkov and Migdal for the case of superconducting systems. Some further applications of their formalism are given both for zero- and for finite temperatures. The pair distribution function of a superconducting system of fermions is calculated by this method. The perturbation theory for impurities in superconductors described by one-particle operators is further discussed. The problem of residual two-body forces in a superconducting system is discussed. A reaction matrix-type treatment of such forces corresponding to a "ladder approximation" perturbation theory is indicated. Author

N65-31506# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.
A NONLINEAR LEAST-SQUARE PROGRAM FOR THE DETERMINATION OF PARAMETERS OF PHOTOPEAKS BY THE USE OF A MODIFIED-GAUSSIAN FUNCTION
Marie Putnam, D. H. Gipson, R. G. Helmer, and R. L. Heath Aug. 1965 92 p refs
(Contract AT(10-1)-205)
(IDO-17016)

A computer program has been written to perform a nonlinear, least-squares fit to a set of data points with one or more Gaussian, or "modified Gaussian", functions. This program was designed for the analysis of gamma-ray spectra obtained with NaI(Tl) scintillation detectors and lithium-drifted germanium detectors. It is used to determine the photopeak positions (gamma-ray energies) and areas for peaks which contain one or more unresolved photopeaks. The functional form used is

$$y(x) = \sum_{j=1}^{J} y_{oj}\, e^{-\left(\frac{x - x_{oj}}{w_{oj}/2\sqrt{\ln 2}}\right)^2} [1 + \alpha_{1j}(x - x_{oj})^{m1} + \alpha_{2j}(x - x_{oj})^{m2}] + a\,x + b$$

where the fit determines the parameters a, b, y_{oj}, x_{oj}, w_{oj}, and α_{ij}. Here m_1 and m_2 are given, even integers. The coefficients a and b describe a straightline component which may be utilized to represent Compton distributions or background which may underlie the photopeak of interest. The input subroutine has been arranged so that a minimal amount of input information is needed when a series of similar fits are to be carried out in succession. Complete listings of the FORTRAN IV program are included along with samples of input to the program and complete instructions for preparing input. Author

N65-31537# Joint Inst. for Nuclear Research, Dubna (USSR).
ELECTROMAGNETIC INTERACTIONS (THEORETICAL) [ELEKTROMAGNITNYE VZAIMODEISTVIYA (TEORIYA)]
A. M. Baldwin [1964] 21 p refs In RUSSIAN Presented at the Intern. Conf. on High Energy Physics, Dubna, USSR, 5–15 Aug. 1964
(JINR-P-1781; Conf-550-66)

Electromagnetic interactions of elementary particles are discussed, and the characteristics of muons and pions are summarized. Unitary symmetry, photoproduction, and electrodynamics of elementary particles are reviewed. E.E.B.

N65-31539# Joint Inst. for Nuclear Research, Dubna (USSR).
NIOBIUM AND RUBIDIUM NEUTRON RESONANCES AND RADIATION WIDTHS OF MEDIUM NUCLEI [NEITRONNYE REZONANSY NIOBIYA I RUBIDIYA I PADIATSIONNYE SHIRINY SREDNIKH YADER]
E. I. Sharapov, L. B. Pikel'ner, N. I. Ilesku, Hi Sang Kim, and Kh. Sirazhet 1964 12 p refs In RUSSIAN
(P-1771; JINR-P-1771)

Neutron resonances and nuclear level widths are discussed with the emphasis on niobium and rubidium. Also, the values of the width of excited level for gamma emission are tabulated for atomic nuclei with A – Z from 30 thru 62 for some 25 selected nuclei. E.E.B.

N65-31541# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ON RELATIVISTIC THREE-BODY PROBLEM [O RELYATIVISTSKOI ZADACHE TREKH TEL]
D. Ts. Stoyanov 1964 12 p refs In RUSSIAN
(P-1777; JINR-P-1777)

An attempt is made to show how analogous equations can be obtained for relativistic three-body problems. The examination considers the Bethe-Salpeter equation for three-particle problems, conjugate interactions, and wave function equations. E.E.B.

N65-31542# Joint Inst. for Nuclear Research, Dubna (USSR).
ASYMPTOTIC PROPERTIES OF SOME HAMILTONIANS ENCOUNTERED IN NUCLEAR PHYSICS. I: ONE PARTICLE EXCITATIONS [ASIMPTOTICHESKIE SVOISTVA NEKOTORYKH MODEL'NYKH GAMIL'TONIANOV V YADERNOI FIZIKE. I: ODNOCHASTICHNYE VOZBUZYDENIYA]
E. Chervonko 1964 13 p refs In RUSSIAN
(P-1744; JINR-R-1744)

The asymptotic properties of some Hamiltonians encountered in nuclear physics are considered and their applications to one-particle excitation problems are discussed. E.E.B.

N65-31544# Comitato Nazionale per l'Energia Nucleare, Ispra (Italy).
LOSS OF CHARGE DUE TO VARIATIONS OF CONTRIBUTIONS OF VERTICAL ADIABATIC MOTION OF TWO-PHASE MIXTURES [PERDITA DI CARICO DOVUTA A VARIAZIONI DI QUOTA NEL MOTO VERTICALE ADIABATICO DI MISCELE BIFASICHE]
V. Magri Dec. 1963 10 p refs In ITALIAN
(GN-40)

Theorems for the conservation of energy and momentum are used in calculating the loss of charge due to vertical adiabatic motion in a two phase mixture. A pipe filled with an incompressible fluid under uniform pressure was used in the experiment. The effects of friction and hydrostatic pressure are considered separately, and calculations for charge loss are presented. Transl. by G.A.L.

N65-31549# Nagoya Univ. (Japan).
ANALYSIS OF THE HIGH ENERGY JET SHOWERS. I: A PROPOSAL OF NEW KINEMATICS
Nobuo Yajima and Shun-ichi Hasegawa (Tokyo Univ.) 28 Sep. 1964 16 p refs
(INSJ-79)

A method is introduced for the kinematical analysis of data obtained from the study of multiple pion production at very high energy, without making use of a symmetry assumption for the angular distribution of pions in the Centre of Mass System. Expressions are derived which, for constant and known transverse momentum of the emitted pions, gives the inelasticity in the Mirror System, the four-momentum transfer and the transverse momentum of the target particles. Introducing the asymmetry factor, which is obtainable appropriately in the practical case, it is shown to be possible to derive formulae which, also for constant and known pion transverse momentum, yield, in good approximation, the total energy and the angular momentum of the pions in the Centre of Mass System, and the Lorentz factor of the Centre of Mass. The new formula for the Lorentz factor is compared with Castagnoli's formula, for the case in which a true asymmetry exists. Author

N65-31593# Brown Univ., Providence, R. I. Dept. of Physics.
[NUCLEAR MAGNETIC RESONANCE STUDIES OF GLASS STRUCTURE IN SEVERAL GLASS SYSTEMS] Annual Summary Report, 10 Oct. 1963–10 Oct. 1964
P. J. Bray [1964] 15 p refs
(Contract Nonr-562(26))
(AD-467109)

Among the data presented on nuclear magnetic resonance (NMR) of glass structure in several glass systems, are the results of a study on the B^{10} and B^{11} NMR spectra obtained from a series of polycrystalline compounds involving tetrahedral bonding of boron atoms to atoms of hydrogen or fluorine. It was found that the B^{10} nucleus was more sensitive to nuclear environment than the B^{11} nucleus. The B^{10} NMR studies were employed to complement and clarify the B^{11} studies, and to clear up ambiguities in the assignments of the values

of the quadrupole coupling constants. Also included are abstracts on $BaO-B_2O_3$ glass system, B^{10} spectra in glasses, B^{11} and Al^{27} in calcium boroaluminate glasses, and temperature dependence of NMR spectra of Li^7 in lithium borate glasses. R.W.H.

N65-31625# Michigan Univ., Ann Arbor. Electron Physics Lab.
HYDRODYNAMIC ANALYSIS OF NOISE IN A FINITE TEMPERATURE ELECTRON BEAM Technical Report No. 83
H. C. Hsieh Griffiss AFB, N. Y., RADC, Jun. 1965 43 p refs
(Contract AF 30(602)-3569)
(RADC-TR-65-110; AD-618694)

On the basis of a small-signal, one-dimensional analysis, a set of basic macroscopic differential equations, governing the fluctuations in quantities such as the electron-beam temperature, the mean velocity and the current density, has been derived by taking moments of the Liouville equation with respect to the velocity variable. This set of differential equations expresses the conservations of charge, momentum and energy, and is valid for an arbitrary amount of velocity spreading and includes the effect of heat conduction. A system of differential equations, governing the correlation among the fluctuations in the mean velocity, current density and beam temperature, is also derived. The relationship among the various noise parameters along the electron beam is obtained in the form of a system of differential equations whose solution gives detailed information on the variation of the noisiness parameter along the beam. The solution of the system of differential equations thus derived is also discussed. Author

N65-31631# Naval Ordnance Lab., White Oak, Md.
THE PHYSICS OF THE BASIC SURGE
Geoge A. Young Aug. 1965 294 p refs
(NOL-TR-64-103; AD-618733)

The column and base surges formed by the underwater nuclear explosion (Test Baker) in Operation Crossroads in 1946 were measured in detail on the original photographic records for a period of 570 seconds. This new set of data, combined with model test results and hydrodynamic and meteorological theory, was used as a basis for formulating a physical explanation of the base surge behavior and for developing prediction techniques. Three minutes after the explosion, convective rainfall had developed within the surge because of the penetration of the top above the lifting condensation level (1500 feet) and the subsequent growth of the cloud droplets by condensation and coalescence. Base surge prediction methods for explosions scaled to Baker were developed for other yields and the effects of different meteorological conditions were described. Author

N65-31645# Naval Ordnance Lab., White Oak, Md.
APPLICATION OF AN ANTICOINCIDENCE-SHIELDED SCINTILLATION SPECTROMETER TO THE STUDY OF THE $N^{14}(p, \gamma)O^{15}$ REACTION
Albert E. Evans, Jr. 11 May 1965 180 p refs
(NOLTR-65-72; AD-618676)

A spectrometer built for studying gamma-ray spectra resulting from nuclear reactions proved useful for gamma-radiation measurements in the energy range from 0.35 to 17.6 MeV. It was also found useful in the study of the $N^{14}(p,\gamma)O^{15}$ reaction for proton bombarding energies from 0.97 to 1.96 MeV. Branching ratios were obtained for the decays of the 8.29, 8.75, 8.92, and 8.98 MeV levels, and angular distribution measurements were made for the most prominent gamma rays. In addition, the yield of gamma radiation to the ground state of O^{15}, to the 5.19 to 5.24, 6.18, 6.79, and 7.55 MeV levels was measured as a function of proton bombarding energy. Off-resonant spectra indicated that the ground-state gamma ray is due partly to the broad $N^{14}(p,\gamma)$ resonance at 2.38 MeV and partly to a nonresonant process. The 6.79 MeV gamma ray is probably due to a direct-capture process. It was shown that there was evidence for direct-capture into the 7.55 MeV level. R.W.H.

N65-31728# Oak Ridge National Lab., Tenn. Isotope Div.
AUTOMATIC STABILIZATION OF A BEAM OF FAST ATOMIC PARTICLES [AVTOMATICHESKAYA STABILIZATSIYA PYCHKA BISTRIKH ATOMNYKH CHASTITS]
V. V. Afrosimov, I. F. Kalinkevich, and I. T. Serenkov Oct. 1964 8 p refs Transl. into ENGLISH from Pribory i Tekhn. Eksperim. (USSR), v. 1, Jan.–Feb. 1964 p 143–146
(ORNL-TR-344)

A method is described for stabilizing the intensity and direction of a beam of fast ions in a device of the mass spectrometer type. The method is based on the direct control of the beam intensity in the device, which is intended for experiments with atomic beams. The principle of the beam stabilization and its experimental achievement are discussed. R.N.A.

N65-31745# Cornell Univ., Ithaca, N. Y.
POINT DEFECT, OPTIC MODE, AND CRITICAL SCATTERING OF PHONONS AT LOW TEMPERATURES
A. J. Sievers and R. O. Pohl 6 Oct. 1964 9 p refs Presented at the 4th Conf. on Thermal Conductivity, San Francisco, 13–17 Oct. 1964 Sponsored in part by ARPA *Its* Rept.-271
(Contract AT(30-1)-2391)
(NYO-2391-5; CONF-764-4)

Three mechanisms for phonon scattering are discussed: 1. The low temperature thermal conductivity of potassium chloride doped with iodide and also doped with lithium is compared with some point defect scattering models. 2. The low temperature thermal conductivity of strontium titanate is observed to vary with applied electric field. The field dependence is associated with the presence of a low frequency optic mode. 3. Anomalous resistance peaks observed near phase transitions in uranium dioxide and potassium dihydrogen phosphate have been identified and interpreted as arising from critical phonon scattering. Author

N65-31748# Argonne National Lab., Ill. Physics Div.
SUMMARY REPORT, APRIL–DECEMBER 1964
[1964] 92 p refs
(Contract W-31-109-ENG-38)
(ANL-6983)

Highlights in basic physics research are reported. Discussed are a newly discovered peak in the s-wave neutron strength function, a versatile neutron time-of-flight analyzer with large memory capacity; radiation width studies of low-energy nuclear states by resonance scattering of thermal-neutron-capture gamma rays; and the magnetic moment of the 26.8-keV state of I^{129}. Also discussed are the interaction between the neutron magnetic moment and the nuclear coulomb field in neutron polarization; configurations of giant resonance; giant dipole resonance and its isobaric-spin mixture; isobaric-analogue states in Cu^{65}; isotope K^{46} produced with the $Ca^{48}(d, \alpha)K^{46}$ reaction; proton capture reactions and residual nucleon-nucleon interactions, (d,n) reactions on medium-weight nuclei; an on-line computing system; and low-lying hole states in the isotopes of scandium. Nuclear spectroscopy, symmetry, particle dynamics, and mass spectrometric studies of vapor ejected from solids by focused laser beams are described; and effective interaction for the lp shell is reported. L.S.

N65-31759# Oak Ridge National Lab., Tenn. Reactor Chemistry Div.

PROPERTIES OF BeO COMPACTS IRRADIATED AT FAST-NEUTRON DOSES GREATER THAN 10^{21} NEUTRONS/CM^2

G.W. Keilholtz, J. E. Lee, Jr., and R. E. Moore [1964] 18 p refs Presented at the Am. Ceramic Soc. Meeting, San Francisco, 28-30 Oct. 1964

(Contract W-7405-ENG-26)

(ORNL-P-631; CONF-792-1)

Continued research conducted under a program designed to determine the effects of high fast-neutron doses at elevated temperatures on pure BeO compacts without additives is reported. One of the major objectives of the program focuses on an evaluation of fast-neutron damage mechanisms under conditions to which BeO moderator bodies may be subjected in nuclear power reactors. Presented are results of experiments to determine the effect of fast-neutron irradiation on sintered BeO compacts of different densities, grain sizes, and specimen sizes; as a function of the flux, dose, and temperature. Included are data from low- and high-temperature irradiation studies; studies of gross damage effects, volume expansion observations, micrographic examinations, x-ray diffraction studies, and single crystal studies. S.C.W.

N65-31760# Franklin Inst., Swarthmore, Pa. Bartol Research Foundation.

STUDIES RELATING TO SCATTERING OF NEUTRONS AND ALLIED PHENOMENA Annual Progress Report, 1964

D. M. Van Patter 25 Sep. 1964 10 p refs

(Contract AT(30-1)-1679)

(TID-21113)

Investigations of the γ-decay modes of many levels in Ni^{58} and Ni^{60} below 4 MeV excitation were carried out by observing $(p'\text{-}\gamma)$ coincidences recorded in a 4096-channel two-dimensional analyzer. Angular distribution measurements for Ni^{60} $(p,p'\gamma)$ radiations revealed an unusual case identified as a 3^+ (E2,M1) 2^+ transition. The E2 decay of the 2.63 MeV 3^+ state to the second 2^+ state is at least 250 times greater than its E2 decay to the first 2^+ state in Ni^{60} indicating its collective properties which would be characteristic of a three-phonon level. It was discovered that $\gamma\text{-}\gamma$ angular correlations in I^{125} and I^{127} were substantially reduced using gaseous rather than solid xenon sources. This strong perturbation in the gaseous phase is attributed to the hyperfine interaction in the highly ionized xenon atoms formed after K-capture. Since the lifetime of the 203-keV level in I^{127} is known to be about 5×10^{-10} sec, this observation yields an approximate lower limit of 300 Mc/sec for the average hyperfine structure constant $\langle a \rangle$. Author

N65-31764# Sandia Corp., Albuquerque, N. Mex. Scientific Translation Service.

PRECISE ABSOLUTE MEASUREMENT OF TRITIUM ACTIVITY. III: ABSOLUTE TRITIUM COUNTING IN INTERNAL GAS COUNTER [PRAZISE ABSOLUTMESSUNG DER AKTIVITAT VON TRITIUM. III: ABSOLUTZAHLUNG VON TRITIUM IM INTERNAL-GAS-ZAHLROHR

A. Spernol and B. Denecke 14 Oct. 1964 11 p refs Transl. into ENGLISH from Intern. J. of Appl. Radiation and Isotopes, v. 15, 1964 p 241-254

(SC-T-64-1636)

A method for the absolute determination of the activity of tritium-tagged water with a reproducibility of 0.1 to 0.2% and an absolute accuracy within 0.3 to 0.4% is described in detail. The theoretical tritium spectrum and the effects leading to its distortion; determination of cut-off energy; determination of correction for the elimination of low-energy decays; measurement of total end and total wall effects; and particular end and wall effects are discussed. E.E.B.

N65-31765# Princeton Univ., N. J. Palmer Physical Lab.

TOPICS CONCERNING COUPLED CHANNEL RESONANCES

L. Zamick 6 Oct. 1964 11 p refs

(Contract AT(30-1)-937; Grant NSF GP-79)

(PUC-1964-154)

The scattering of a particle by a target with two states separated by an energy difference is considered. The coupled Schroedinger equation is solved on an IBM 7090 computer and resonances due to the channel coupling are found. The behavior of the reaction matrix below and above threshold is examined. It is found that in addition to the narrow resonances below threshold there are narrow antiresonances above threshold. The antiresonance structure is not present in the scattering matrix and hence is not experimentally observable. This is related to the Wigner limit on the rate of change of a phase shift with respect to wave number. A separate topic is considered concerning the effect upon the width of a resonance of the surface thickness of a potential. Both single particle resonances and coupled channel resonances are considered. An example of an anomalous behavior in the coupled channel case is shown, where making the potentials more diffuse causes the reduced width of resonances to decrease. Author

N65-31766# California Univ., Berkeley. Lawrence Radiation Lab.

PRODUCTION OF COSMIC RAYS BY BETATRON ACCELERATION AND STRUCTURE OF EXTRAGALACTIC RADIO SOURCES

Nicola Cabibbo 10 Feb. 1964 8 p refs Presented at Am. Phys. Soc., Spring Meeting, Washington, D. C., 27-30 Apr. 1964

(Contract W-7405-ENG-48)

(UCRL-11204; CONF-452-58)

Presented is a discussion of the possible role of the betatron effect as a mechanism for the acceleration of cosmic particles to relativistic energies. On the basis of a hypothesis that this mechanism can be extremely efficient in a region where the magnetic field is zero, or very small compared with time-dependent magnetic fields in nearby regions, a possible model for extragalactic radio sources is described. It is shown that a zero-field region can provide an efficient method of continuous injection and acceleration. Although the model is capable of explaining some of the more striking peculiarities of the sources, as the double structure and the distance from the main visual object, further studies are being pursued in an attempt to solve quantitative problems associated with its use. S.C.W.

N65-31769# Cornell Univ., Ithaca, N. Y.

INTERNAL FRICTION AND ELECTRON MICROSCOPY STUDIES ON MAGNESIUM

Robert Tsang-Chu Tsui (Ph.D. Thesis) Sep. 1964 72 p refs

(Contract AT(30-1)-2471)

(NYO-2471-3)

Internal friction of polycrystals and single crystals of pure and doped magnesium was studied between 4.2° and 300° K at frequencies of about 4 and 40 kc. Two kinds of internal friction peaks were found in plastically deformed specimens. A broad peak, which shows some structures and occurs between 70° and 240° K in both polycrystals and single crystals after coldwork, was caused by dislocations in the basal slip system. Dislocations in the prismatic and pyramidal glide systems do not contribute to the internal friction. The peak at 20° K appears in polycrystals only after a large amount of coldwork. This peak was not caused by dislocations in the basal, prismatic, or pyramidal systems. Effects of different impurities, in particular precipitates, were observed. Direct observations of dislocation structures were obtained using transmission electron microscopy. The observations correlate with the internal friction results. R.N.A.

N65-31772# California Univ., Berkeley. Lawrence Radiation Lab.

THE VARIATIONAL METHOD IN ELECTRON-HYDROGEN SCATTERING

Robert Louis Armstead (Ph.D. Thesis) 3 Sep. 1964 29 p refs

(Contract W-7405-ENG-48)

(UCRL-11628)

The Kohn variational principle is used to calculate p-wave phase shifts for the elastic scattering of electrons from a neutral hydrogen atom at subexcitation energies. The trial wave function is represented on a basis which simplifies algebraic and numerical work. It is found that a careful treatment avoids the usual pitfalls of variational scattering calculations and yields quite accurate results. Singlet and triplet p-wave phase shifts are tabulated and compared with other calculations. Similar calculations for s-wave and p-wave positron-hydrogen scattering are carried out and tabulated. Author

N65-31774# Radiation Research Associates, Inc., Fort Worth, Tex.

REFLECTION OF THERMAL NEUTRONS AND NEUTRON-CAPTURE GAMMA RAYS FROM CONCRETE

M. B. Wells 12 Jun. 1964 23 p refs Presented at Ann. Meeting of the Am. Nucl. Soc., Philadelphia, 14–17 Jun. 1964

(Contract W-7405-ENG-26)

(RRA-M44; CONF-446-40)

Monte Carlo methods were used to compute thermal-neutron and thermal-neutron capture-gamma ray differential albedos for TSF and Portland concretes. The results obtained for the thermal-neutron differential albedo for Portland concrete were fitted by the equation

$$0.21\cos^{2/3}\theta_0\cos\theta$$

where θ_0 and θ are the angles of incidence and reflection respectively. The total thermal-neutron flux reflected per unit incident flux was found to be given by $0.414\ \pi\cos\theta_0$ for TSF concrete and $0.42\ \pi\cos^{2/3}\theta_0$ for Portland concrete. The Monte Carlo calculations of the capture-gamma dose reflected from concrete per unit incident thermal-neutron flux were fitted by the expression

$$1.046 \times 10^{-5}\cos^{5/4}\theta_0\cos^{2/3}\theta$$

for TSF concrete and by the expression

$$6.986 \times 10^{-6}\cos\theta_0\cos\theta$$

for Portland concrete. The units of the above albedos are erg, g^{-1}, hr^{-1}, $steradian^{-1}$ per unit incident thermal-neutron flux. The Monte Carlo calculations were found to be in reasonably good agreement with albedo expressions derived by both Fermi and Halpern, et al. Calculations of the thermal-neutron capture-gamma dose rates inside 4 ft. diameter concrete-lined cylindrical holes dug in the ground at the Oak Ridge National Laboratory's Tower Shielding Facility show that the major component of the gamma dose rate is that resulting from thermal-neutron capture in the concrete walls. Author

N65-31780# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy).

VECTOR AND AXIAL CURRENTS UNDER FIRST ORDER SYMMETRY BREAKING

R. Gatto 22 Feb. 1965 17 p refs Presented at Erice Summer School, Aug. 1964 *Its* Nota Interna No. 273

(LNF-65-7)

An analysis of weak, and electromagnetic, vector and axial currents, with first order symmetry breaking is reported. It is shown that under the following two general assumptions that: (1) the vector currents and the electromagnetic current belong to the same unitary octet, and (2) the breaking of unitary symmetry is due to a term behaving like the eighth component of an octet; the following result holds: to first order in the symmetry-breaking interaction, all the vector coupling constants are not renormalized. A significant aspect of the proof of the first assumption is that the electromagnetic current is formed out of the currents of the vector octet, implying that the current under study has a definite behavior under charge conjugation. A definite C character of the currents (odd for vector and even for axial) implies their definite CP character, even for both vector and axial. The consequences derived for currents with non-definite behavior under CP, with connected implications on time reversal, are briefly surveyed. S.C.W.

N65-31781# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy).

RECENT CALCULATIONS ON ELECTRON-POSITRON COLLIDING BEAM EXPERIMENTS

R. Gatto 27 Feb. 1965 15 p refs *Its* Nota Interna No. 274

(LNF-65/8)

Continued research related to the Adone project of colliding $e^+ - e^-$ beams is reported. Cited are radiative corrections to $e^+ + e^- \rightarrow \mu^+ + \mu^-$. A tentative estimate of the higher order corrections in α was obtained using renormalization group techniques. Results show that the higher order terms play a minor role for colliding beam experiments in the energy ranges under study. Included are graphs contributing to the lowest order radiative corrections to $e^+ + e^- \rightarrow \mu^+ + \mu^-$. Also mentioned are references on the use of colliding beams to explore strong and electromagnetic interactions, and a method for determining the η° lifetime with electron-positron colliding beams. S.C.W.

N65-31783# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali.

PRODUCTION AND DISCHARGE OF POISONOUS GAS AND RADIOACTIVITY IN THE LINAC TUNNEL OF FRASCATI [PRODUZIONE E SCARICO DI GAS TOSSICI E RADIOATTIVI NEL TUNNEL DEL LINAC DI FRASCATI]

M. Ladu, M. Pelliccioni, and M. Roccella 28 Jun. 1965 13 p refs In ITALIAN *Its* Nota Interna No. 282

(LNF-65/21)

Safety factors in the production and discharge of the poisonous gases NO_2 and O_3, of nuclide O^{15}, N^{13}, (radioactive B^+, and of Cl^{38} (radioactive) β^- and γ) in the Frascati linac tunnel are considered. Calculations show that a ventilation capacity of 60 m^3/min. reduces the concentration of NO_2 and O_3 present in the tunnel to a safe level. Transl. by G.A.L.

N65-31784# Nihon Univ., Tokyo (Japan). Coll. of Science and Engineering.

THE ELASTIC SPHERE MODEL OF ELEMENTARY PARTICLES AND ITS RELATION TO THE QUADRILOCAL FIELD MODEL

Tetsuo Goto [1965] 27 p refs

(NUP-65-8)

The quantum theory of an elastically isotropic and spherically symmetric body is developed both in non-relativistic and relativistic way. It can be shown that the model considered in this note is kinematically equivalent to the quadri-local field

model proposed by Yukawa et al and T. Takabayasi and, therefore, in the same way as Takabayasi did, we can construct baryonic states by irredicible representations of SU(3) group. In connection to the relativistic formulation of the model, we also study the relativistic rigid body motion. Author

N65-31802# United Kingdom Atomic Energy Authority, Harwell (England). Research Reactors Div.

ATTEMPTS TO DETERMINE THE FAST-NEUTRON SPECTRUM IN A THERMAL REACTOR BY MEANS OF Li^6 AND He^3 SEMICONDUCTOR SPECTROMETERS

M. G. Silk May 1965 26 p refs

(AERE-M-1590) HMSO: 3s 6d

Helium-3 and lithium-6 semiconductor neutron spectrometers have been used to determine the fast-neutron spectrum in GLEEP, a thermal reactor with a graphite moderator. A fast electronic circuit of resolving time 100 nsec has been used to eliminate pileup effects as far as possible, and by combining the results obtained from both spectrometers the neutron spectrum has been determined over an energy range from 0.8 MeV to 6.4 MeV. The experimental spectra are shown to be in agreement with theoretical spectra derived by Monte-Carlo calculations. The results suggest that silicon-neutron reactions are relatively unimportant in this case. A small peak observed in the lithium-6 spectra may confirm that there is a discontinuity in the cross-section for the $Li^6(n,\alpha)H^3$ reaction in the neutron-energy region between 2 MeV to 2.5 MeV. Author

N65-31813# Los Alamos Scientific Lab., N. Mex.

DIFFUSION OF NEUTRONS FROM A POINT SOURCE IN AN EXPONENTIAL ATMOSPHERE

Marshall Rosenbluth 12 Aug. 1965 12 p

(Contract W-7405-ENG-36)

(LA-3349-MS) CFSTI: $1.00

The transport, capture, and scattering cross sections of neutrons in an exponential atmosphere are considered. It is found that the transport cross section in the neighborhood of 1 MeV is close to 2 barns and that the square root of the capture cross section and transport cross section product at thermal energy is about 4 barns. Using 2 barns as the critical cross section and 6.7 km as the e-folding distance, the critical height of burst is found to be about 110000 feet. For bursts at 70000 feet or below, the method presented is considered reliable. At 110000 the method becomes marginal because of the use of diffusion theory. For bursts less than one mean free path from the top of the atmosphere, a mockup of a source after a few collisions is reasonable such that all neutrons have either escaped or arrived at one mean free path in depth. This introduces a radial spread in the distribution. E.E.B.

N65-31837# California Univ., Berkeley. Dept. of Physics.

HIGH DYNAMIC POLARIZATION OF PROTONS

T. J. Schmugge and C. D. Jeffries Nov. 1964 65 p refs Submitted for Publication Supported in Part by AEC and ONR

(AD-463800)

A study of the dynamic polarization of protons in the waters of hydration of the lanthanum magnesium nitrate crystal containing a small fraction of neodymium is reported. Focused on are the spin-phonon dynamics of the crystals as: relaxation times, the dynamic polarization process, the magnitude of the polarization, and its build up and decay. Described are experimental methods of dynamic orientation which utilized an elementary phenomenological approach to predict the dynamical behavior; and a polarization apparatus for use at frequencies up to 75-kMc, and temperatures $1.3° < T < 4.2°$ K. Presented are results of dynamic proton measurements made over a wide range of frequencies and temperatures. At 75-kMc and 1.5° K, a polarization of at least 70% was observed. The successful use of the crystal in the construction of sizeable polarized proton targets is also cited. S.C.W.

N65-31863# Columbia Univ., New York. Columbia Radiation Lab.

RESEARCH INVESTIGATION DIRECTED TOWARD EXTENDING THE USEFUL RANGE OF THE ELECTROMAGNETIC SPECTRUM Second Quarterly Progress Report, 16 Mar.–15 Jun. 1965

R. Novick 15 Jun. 1965 70 p refs

(Contract DA-28-043-AMC-00099(E))

(PR-10; AD-467754)

Successful observations have been made on the spectra of 6328Å light scattered from carbon dioxide near the critical temperature T_c and critical density ρ_c. A technique has been developed for measuring the two relaxation times characterizing the disorientation of optically aligned atoms in a vapor. The method consists of alternately exciting pure dipole or pure quadrupole components of the density matrix which give rise to $\Delta m = 1$ zero-field level-crossing signals. The excitation energies of the metastable autoionizing atomic states in the alkali atoms have been remeasured using an electron gun with much better energy resolution. The value of the differential Stark shift in the $^3P_1$ excited state of Hg measured by level crossing in signals in parallel electric and magnetic fields has been found to be 2360 ± 70 cps/(kV/cm)^2. Author

N65-31921# European Atomic Energy Community, Brussels (Belgium).

ON THE INTERPRETATION OF THE EXPONENTIAL EXPERIMENT IN NATURAL URANIUM

R. Dierckx, G. Kistner, and R. Misenta 1965 25 p refs

(EUR-2413.e) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 40 Belg. Fr.

A summary of the results of two exponential experiments in natural uranium is given. The experiments have been performed at Los Alamos and at Saclay. The experiments have been analyzed and a systematic difference of the relaxation lengths, measured with detectors sensitive to high and low energy neutrons, has been found. This systematic difference disappears by applying corrections in function of the energy of the detected neutrons. These energy dependent corrections increase the asymptotic diffusion length by about 1% for both experiments, compared with the asymptotic diffusion length obtained by energy independent corrections. Author

N65-31965# Wisconsin Univ., Madison. Mathematics Research Center.

ON THE ESSENTIAL SPECTRUM OF THE HYDROGEN ENERGY OPERATOR

P. A. Rejto Jan. 1965 52 p refs

(Contract DA-11-022-ORD-2059)

(MRC-540; AD-614933)

The essential spectrum of the hydrogen energy operator, i.e. of $-\Delta - 1/r$ is determined by showing that $1/r$ is Δ-compact. It is noted that this situation is typical for a wider class of problems. Author

N65-31971# California Univ., Santa Barbara. Dept. of Physics.

QUANTITATIVE STUDIES BY OPTICAL SPECTROSCOPY OF ENERGY EXCHANGE MECHANISMS IN SIMPLE GASES AND SOLIDS Techical Report, 1 Jan.–1 Jul. 1965

H. P. Broida 1 Jul. 1965 26 p refs

(Contract Nonr-4222(01); ARPA Order 125)

(TR-11; AD-617797)

The effects of impurities and temperature variation on free carrier mobilities in solid and liquid argon and krypton, in condensed phase experiments, were investigated. Equipment and techniques were developed to observe Raman and Brillouin scattering in CS_2 and benzene liquids. In emission studies, the addition of volatile silicon compounds to active nitrogen yielded new information on the electronic states of SiN, including the existence of a large vibration population inversion in the $B^2\Sigma$ state of the compound. In a study of N_2^+, a detailed perturbation calculation on the mutual interaction between the v = 1 level of the $B^2\Sigma$ state and the v = 11 level of the $A^2\Pi$ state was completed. Order of magnitude calculations for the interaction predict energy shifts comparable with experimental values. Populations of vibrational and electronic states of N_2^+ excited in a helium afterglow were obtained over a large pressure range. Electron density and temperature measurements for a spectroscopic and Langmuir probe study of hydrogen negative glow plasma indicate that the plasma is beam generated and diffusion controlled. A value for the ambipolar diffusion coefficient was deducted. L.S.

N65-32004# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A CREATIVE RAY
N. Basov and V. Leshkovtsev 20 May 1965 9 p Transl. into ENGLISH from Izv. (Moscow), 12 Jul. 1964 p 5
(FTD-TT-65-121/1; AD-617655)

The property of an atom to absorb and emit electromagnetic radiation is discussed, and the history of the development of quantum generators and amplifiers is reviewed. Semiconductor quantum generators based on the p-n transitions in gallium arsenide and cadmium sulfide are described. Also, the possibility of transmitting energy without wires in the form of light and transforming radiation energy into electrical energy is considered. E.E.B.

N65-32043*# Southern Methodist Univ., Dallas, Tex.
BASIC RESEARCH IN SEMICONDUCTOR DETECTOR-DOSIMETER CHARACTERISTICS, AS APPLIED TO THE PROBLEMS OF WHOLE BODY DOSIMETRY Annual Progress Report
Jul. 1965 52 p refs
(Grant NsG-708)
(NASA-CR-64562) CFSTI: HC $3.00/MF $0.50 CSCL 18D

Various facets of experimental and theoretical research were reported, including fabrication of lithium drifted silicon semiconductor detectors; stopping power measurements; charge-pulse response of silicon detectors; detector lifetime behavior studies; linear and Monte Carlo stopping power calculations; calculation of effective Z, A, and I values; and depth dose distribution calculations. A method for extracting information from proton stopping experiments is described: in this experimental study, the objective is to assess values of parameters in the Bethe–Block formula that describe the average rate of energy lost by a charged particle along the path of migration in matter in interactions with atomic electrons. A computer program on the Monte Carlo proton transport is presented, and data sheets are included for a test problem in which the slowing down of protons in silicon from 187 to 147 MeV is studied. Abstracts of studies on related subjects are also included. M.G.J.

N65-32048*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
THE QUANTUM CORRECTIONS TO THE TRANSPORT COLLISION INTEGRALS
Herbert T. Wood 10 Aug. 1965 99 p
(Grant NsG-275-62)
(NASA-CR-64558; WIS-TCI-III) CFSTI: HC $3.00/MF $0.75 CSCL 20J

The second quantum correction to the phase shift in a collision between particles with spherically symmetric potentials is obtained, using the method of Curtiss and Powers. In this expression the potential is not restricted to monotonic functions; the results apply to a potential with an attractive minimum. The classical limit and the first quantum correction, both developed earlier for monotonic potentials, are also rederived so that they may be used with potentials possessing a minimum. These expressions are then used to develop series expressions for $\Omega^{(1)}$ and $\Omega^{(2)}$, the so-called cross sections for diffusion and viscosity, respectively. These expressions for $\Omega^{(1)}$ and $\Omega^{(2)}$ are used to obtain the classical limit and the quantum corrections to the transport collision integrals. Author

N65-32156*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NUMERICAL CALCULATION OF POTENTIAL-ENERGY CURVES BY THE RYDBERG-KLEIN-REES METHOD
Frank J. Zeleznik 23 Sep. 1964 8 p refs Submitted for Publication
(NASA-TM-X-54805) CFSTI: HC $1.00/MF $0.50 CSCL 20J

A technique is presented for the numerical evaluation of the integrals occurring in the Rydberg-Klein-Rees method of calculating potential energy curves. Author

N65-32158*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
CYCLOTRON TESTS TO DETERMINE THE RESPONSE OF SOLID-STATE DETECTORS TO PROTONS OF ENERGIES 50 TO 160 MEV FOR USE IN A PROTON SPECTROMETER
Gary W. Grew [1964] 12 p refs Presented at the 11th Nucl. Sci. Symp., Philadelphia, 28–30 Oct. 1964
(NASA-TM-X-54822) CFSTI: HC $1.00/MF $0.50 CSCL 20H

In conjunction with a feasibility study of a proposed proton spectrometer for analyzing protons over an energy range 0.5-Mev to greater than 200-Mev, cyclotron tests were conducted on fully depleted solid-state detectors to determine their response to protons of energies varying from 50 to 160-Mev. Major parameters determined were the most probable energy loss in the detector by protons of energy E and the resolution of the energy loss distribution. Proton energy-loss distributions appeared to be in agreement with Symon's theoretical approach to the problem, and therefore, Symon's distribution curves can be applied in data reduction of information extracted from the spectrometer. Although further investigation of these distributions is required to determine the practical limits of the energy ranges for the proposed spectrometer, it appears feasible to design a proton spectrometer that could have several energy windows extending up to and beyond 200-Mev. S.C.W.

N65-32168*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECTS OF NUCLEAR STRUCTURE ON THE SCATTERING OF POLARIZED PROTONS
E. T. Boschitz, R. W. Bercaw, and J. S. Vincent 6 Oct. 1964 6 p refs Submitted for Publication
(NASA-TM-X-54711) CFSTI: HC $1.00/MF $0.50 CSCL 20H

Previously, it was found that the polarization of protons in elastic scattering varies rapidly at large angles as a function of the mass number whereas the optical model predicts a smooth dependence. It was suggested that the spin-orbit potential may depend on the closing of shells or have an isospin dependence as does the central potential. An experiment is described to explore any such structural effect on the polarization for the A^{40}-Ca^{40} pair and to extend some of the previous measurements on other nuclei in the 16 to 21 MeV range. The polarization was determined by measuring the right-left asymmetry in the scattering of a polarized proton beam. Comparisons of the polarizations produced by A^{40} and Ca^{40} at several

different bombarding energies are shown. It was found that the structure of the nucleus affects the elastic proton polarization at a mass number of 40. The results on heavier nuclei are not yet clear but the influence of nuclear structure appears to decrease with increasing mass number. E.E.B.

N65-32190*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
THE QUANTUM MECHANICAL BOLTZMANN EQUATION
David K. Hoffman, John J. Mueller, and C. F. Curtiss 13 May 1965 28 p refs
(Grant NsG-275-62)
(NASA-CR-64438; WIS-TCI-95) CFSTI: HC $2.00/MF $0.50 CSCL 20J

A Boltzmann equation is derived from the N-particle Schroedinger equation. The development is based on the solution of the two particle quantum mechanical Liouville equation due to Green. The various approximations involved in the derivation are discussed and the collision integral and corrections are compared to their classical analogs. Further development of the collision integral yields the standard result, the usual Boltzmann collision integral in which the classicial differential cross section is replaced by its quantum mechanical counterpart. Author

N65-32195*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
THE QUANTUM CORRECTIONS TO THE TRANSPORT COLLISION INTEGRALS, PART 2
Herbert T. Wood 10 Aug. 1965 79 p refs
(Grant NsG-275)
(NASA-CR-64463; WIS-TCI-111, Pt. 2) CFSTI: HC $3.80/MF $0.75 CSCL 20J

The first and second quantum corrections to the cross sections $Q^{(1)}$ and $Q^{(2)}$ for collisions involving spherically symmetric potentials were obtained. This paper is based on expressions for the phse shifts obtained by previous investigators. These expressions are not restricted to monotonic potentials. The expressions differ from those of Kahn, because of the use of a different boundary condition. The important feature of this work was the introduction of the concept of the classical limit and the distinction between this and the classical result. The coreless square well potential was studied to demonstrate this difference because the integrals involved are known. The numerical results for the phase shift, using the Lennard-Jones potential, substantiates the expression for this classical limit. Three sets of computer programs wer used in the numerical evaluation of the expressions obtained, one set for each potential. R.W.H.

N65-32240# Controls for Radiation, Inc., Cambridge, Mass.
RADIATION FACILITY SUPPORT AND SOLID-STATE STUDIES Final Report
James A. Wall, Charles J. Glassbrenner, Sumner Mayburg, and Martin Fritts 16 Jun. 1965 78 p refs
(Contract AF 19(628)-4036)
(AFCRL-65-375; AD-618304)

Final acceptance test procedures for a linear accelerator are given, and test results are tabulated. An interlock system was designed and operation of the system is described. Instrumentation, an ionization chamber, and a device for determining electron energy by range measurement are discussed. A low temperature thermal conductivity apparatus was designed to measure samples that were bombarded at low temperatures. Determination of oxygen concentration in silicon to levels as low as 10^{13} atoms/cm^3 by means of photonuclear activation analysis is also discussed. Initial tests of the technique were performed, and the optimum operating electron energy of the accelerator for photoactivation of oxygen is computed to be 19.4 MeV. Ozone detection for measuring potentially hazardous ozone concentrations, and for determining the effects of ozone on radiation damage experiments performed in air was investigated, and a prototype detector based on the absorption of 2537 Å ultraviolet light was constructed. Development of a source for the production of nearly monoenergetic 120 keV neturons is also reported. C.T.C.

N65-32252*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
RADIATION PHYSICS RESEARCH AT MSFC: RESEARCH ACHIEVEMENTS REVIEW SERIES
Russell D. Shelton 1 Jul. 1965 39 p refs
(NASA-TM-X-53301) CFSTI: HC $2.00/MF $0.50 CSCL 20H

This report presents the status and accomplishments of the Marshall Space Flight Center research program in the area of radiation physics. It relates in general terms the MSFC research effort concerned with radiation effects upon materials, testing of electronic components in radiation fields, shielding from nuclear and space radiation, plasma physics, and electromagnetic shielding. It describes the MSFC research facilities for radiation physics. References include the major MSFC research contracts and publications in the field of radiation physics. Author

N65-32310# Commissariat a l'Energie Atomique, Paris (France). Centre d'Etudes Nucleaires.
THE INFLUENCE OF RADIOACTIVE RADIATION AND OF SPACE CHARGE ON THE TRAJECTORY OF LIGHTNING [L'INFLUENCE DES RAYONS RADIOACTIFS ET DE CHARGES SPATIALES SUR LA TRAJECTOIRE DE LA FOUDRE]
Dietrich Mueller-Hillebrand 20 Mar. 1964 15 p refs Transl. into FRENCH from Elektrotech Z. (W. Berlin), v. 83A, no. 5, 1962 p 152-157
(CEA-TR-A-1471)

Investigations were made into the influence of radioactive radiation on the trajectories of lightning. The effect of space charges, produced in the form of corona discharges emitted from the sun, is also considered. It has been shown experimentally that corona currents attaining 8 mA are able to change the electric field intensity of large lightning flashes at their origin. Currents emitted by radioactive lightning rods, in comparison, are too weak to create the necessary space charges to effect lightning. They must be one hundred thousand times stronger in order to effect an electric field at a distance of several hundred meters. Transl. by G.A.L.

N65-32318# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.
PULSE SHAPE DISCRIMINATION OF IONIZING PARTICLES WITH SCINTILLATION COUNTERS [SULLA DISCRIMINAZIONE TRA DIVERSI TIPI DI PARTICELLE IONIZZANTI MEDIANTE LIANALISI DELLA FORMA DELL'IMPULSO DI SCINTILLAZIONE]
M. Grandolfo 15 Jun. 1964 35 p refs In ITALIAN
(ISS-64-23)

An IBM 7040 computer program is presented for performing calculations involved in a method of discriminating impulses caused by various types of ionized particles. Included are the experimental results obtained when the computer calculations are applied to a detector incorporating a Trans-Stilbe crystal, for cases in which α-particles are to be discriminated from γ rays. Transl. by G.A.L.

N65-32330# California Inst. of Tech., Pasadena. Synchrotron Lab.
SELECTIVE DETECTORS FOR HIGH-ENERGY PHOTONS AND ELECTRONS

Clemens A. Heusch and Charles Y. Prescott 29 Jan. 1964 25 p refs Presented at the Am. Phys. Soc. 1963 Winter Meeting, Pasadena, Calif., 19–21 Dec. 1963
(Contract AT(11-1)-68)
(CTSL-41; Conf-417-32)

For fast identification of high-energy electrons and photons in heavy backgrounds, a counter was developed consisting of successive layers of lucite and lead. Cerenkov radiation emitted in the lucite slabs is collected onto the photocathode of one 5 inch phototube. The geometry as well as the thickness of inserted lead converters can be adapted to kinematical requirements. At 1 BeV/c incoming momentum, the rejection ratio of e, γ showers vs. π or μ is better than 100:1; i.e., proper discrimination setting will allow rejection of 99% of all π's and μ's, while only 1% of e's and γ's will be lost. Protons make no pulses at all. The response over the face of the counter is uniform. The properties of the counter are checked in detail against the behavior of lead glass Cerenkov counters, and of lead scintillator sandwiches of comparable geometry. Many applications appear to favor this type of counter over others operating on conventional principles.
Author

N65-32363# Stanford Univ., Calif. Stanford Linear Accelerator Center.
THE NATURAL COORDINATE SYSTEM FOR STUDYING VECTOR PROBLEMS
E. L. Chu Jun. 1965 48 p refs
(Contract AT(04-3)-400)
(SLAC-46) CFSTI: $3.00

A nonorthogonal curvilinear coordinate system which has a curved nonplanar vector line for its coordinate axis is described. Important formulas concerning the metric properties of nonorthogonal curvilinear coordiate systems are included. Special emphasis is given to the concepts of covariant and contravariant base vectors. Frenet's formulas are considered in detail. A discussion of covariant–contravariant transformations based upon the fact that not only scalars but also tensors of different ranks are invariant quantities under transformation is included. The gradient operator, Christoffel symbols, and the Laplacian expression of a vector field are also presented.
G.A.L.

N65-32374# Battelle-Northwest, Richland, Wash.
PHYSICS RESEARCH QUARTERLY REPORT, JANUARY, FEBRUARY, MARCH, 1965
R. A. Harris et al [1965] 56 p refs
(Contract AT(45-1)-1830)
(BNWL-95) CFSTI: $3.00

Research in the area of reactor, experimental and critical mass physics has been compiled. Work reported includes a comparison of measured and calculated spectra and average reaction rates; a comparison of diffusion and transport calculations for the NPR unit cell; a determination of a value for k_∞ for a PuO_2-UO_2 graphite lattice; critical experiments with homogeneous PuO_2-polystyrene compacts; prompt neutron decay using Monte Carlo methods of analysis, and an interpretation of pulsed neutrons and reactor noise experiments in reflected reactors.
G.A.L.

N65-32387# California Univ., Livermore. Lawrence Radiation Lab.
THE ANALYSIS OF DIFFUSION DATA
David Y. F. Lai 27 Aug. 1964 10 p
(Contract W-7405-ENG-48)
(UCRL-12051-T)

The importance of minimizing or eliminating errors due to the experimental techniques used in determining diffusion data is pointed out. The sectioning and residual counting technique is briefly reviewed, and expressions for the volume diffusion process are given. Errors due to heat-up time correction, incorrect area measurement, constant background, and incorrect reference plane are considered, and their effect on the results in tracer diffusion studies are discussed. Equations for correcting these errors are presented.
M.G.J.

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N65-31280 Joint Publications Research Service, Washington, D. C.
RADIATION OF EXTRAORDINARY WAVE FROM A MAGNETOACTIVE PLASMA LAYER WITH CURRENT
M. V. Samokhin *In its* Izv. VUZov: Radiofiz., Vol. VIII, No. 2, 1965 10 Aug. 1965 p 44–55 refs (See N65-31275 20-23) CFSTI: $6.00

The author considers the problem of the radiation of a plane layer of magnetoactive plasma with current. It is assumed that the magnetic field is perpendicular to the boundaries of the layer, and that the variation of the magnetic field and density is small. The refractive index of the extraordinary wave has a pole at the point where the radiation frequency and the gyro frequency of the electrons coincide, and the wave equation reduces to a nonhomogeneous degenerate hypergeometric equation, for which a solution and asymptotic expansion are found. A graph is presented for the distribution of the electric and magnetic fields in the layer. There is a discussion of a method of determining the electron density in such a layer from the reflection or transmission coefficients of the extraordinary wave.
Author

N65-31303 Joint Publications Research Service, Washington, D. C.
DETECTION OF CENTIMETER WAVES IN A GAS DISCHARGE PLASMA
G. A. Sobol' *In its* Izv. VUZov: Radiofiz., Vol. VIII, No. 2, 1965 10 Aug. 1965 p 273–275 (See N65-31275 20-23) CFSTI: $6.00

Comparison of three detector characteristics for the same gas discharge plasma indicates that the detecting properties of a plasma are over a broad frequency range, which enables the construction of a detector of unlimited power with frequencies from 20 to 10^{10} cps. The detector can be tuned by changing the probe voltage with respect to the anode. It was shown that detector effect was observed only during the exposure of the precathode discharge region to a super high frequency field; the detector effect is not seen in arc discharge and other discharge regions. Magnitude of detector effect was found to be dependent upon cathode material and gas in the tube but independent of anode and probe material.
M.W.R.

N65-31523# Los Alamos Scientific Lab., N. Mex.
THE DEVELOPMENT OF AN INTERLEAVED, FRACTIONAL-TURN COIL
R. S. Dike, E. L. Kemp, and J. Marshall [1964] 17 p refs Sponsored by AEC

Certain types of theta pinches require high theta voltages around the coil. This leads to very high voltage, 50–100-kV capacitor banks. Such banks are difficult to build and operate. The theta pinch at Frascati, Italy, obtains high voltages by connecting six, 20-kV capacitor banks in series at equal intervals around a one-turn coil. At Jülich, Germany, the collector plate feeding a one-turn coil is split into many parallel

sections. This lowers the inductance of the collector plate and greatly alleviates the problem of containing the large magnetic forces that are created by peak currents of many kiloamperes flowing through the collector into the coil. An interleaved, fractional-turn coil design is explained, and the current flow in the coil is discussed. A quarter-turn, 9-in diam, 11-in.-long coil was built and connected to four 25-kV banks with a combined energy of 25 kJ. The system produced 63-kV theta voltage around the coil and generated 13 kG rising in 1.6 μsec. This coil is shown, and the mechanical and electrical advantages are discussed. Author

N65-31590# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF HIGH TEMPERATURE PLASMA IN CZECHOSLOVAKIA AND ITS PERSPECTIVES
Jan Vana 15 Jul. 1965 14 p Transl. into ENGLISH from Vestn. Cesk. Akad. Ved. (Czechoslovakia), no. 5, 1963 p 558–562
(FTD-TT-65-367/1+4; AD-466928)

An elementary discussion is presented of plasmas related to thermonuclear reactions used in creating energy sources. Topics discussed include methods of controlling the combination of nuclei of light elements; the world status of plasma investigation; and high temperature plasma investigations in Czechoslovakia. A projection is made of main problems to be solved in the future. C.T.C.

N65-31595# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
PLASMAS IN CUSPED MAGNETIC FIELDS AND SIMILAR GEOMETRIES Annotated Bibliography
E. J. Blau Aug. 1964 49 p refs
(Contract NOw-62-0604-c)
(TG-230-B4; AD-451426)

An annotated bibliography is presented on plasmas in cusped magnetic fields and similar geometries. R.N.A.

N65-31682# General Electric Co., Philadelphia, Pa. Space Sciences Lab.
FUNDAMENTALS OF MHD FLOW Final Report
Arthur Sherman Jun. 1964 14 p refs
(Contract AF 49(638)-914)
(AFOSR-64-1425; AD-617562)

Various studies on magnetohydrodynamic phenomena associated with crossed field devices are reviewed. These included investigations of the properties of low temperature plasmas; analyses of channel flow problems; discussions of related boundary layer phenomena; and the application of channel flow solutions to accelerators and generators. The development of some new concepts for the macroscopic description of the nonequilibrium ionization idea was also reported. C.T.C.

N65-31698# Los Alamos Scientific Lab., N. Mex.
REVIEW OF CONTROLLED THERMONUCLEAR RESEARCH AT LOS ALAMOS, 1965
J. L. Tuck et al 17 Aug. 1965 106 p refs
(Contract W-7405-ENG-36)
(LA-3253-MS, Rev.) CFSTI: $4.00

The past history, present status, and future plans of the Los Alamos Scientific Laboratory Sherwood program are discussed. A case is presented for pulsed high-density high-β plasmas as a promising route to power producing thermonuclear reactions. A proposal for a closed toroidal theta-pinch experiment (Scyllac) is given. Preliminary plans are also given for a closed flute-stable system—the Caulked Cusp. Author

N65-31721# Innsbruck Univ. (Austria). Inst. for Theoretical Physics.
INTERACTION BETWEEN MAGNETIC FIELD AND FLOW FIELD FOR PLASMAS OF INFINITE CONDUCTIVITY Scientific Report No. 17
Ferdinand Cap and Gerold Kerer 15 Oct. 1964 8 p ref
(Contract AF 61(052)-675)
(AFOSR-65-0933; AD-617553)

Assuming that the boundary curve of a two-dimensional steady flow is given analytically and that the magnetic field in the whole flow domain is vertical to the flow velocity, a method is presented to calculate the magnetic field at the boundary. The method is demonstrated for a magnetic field at the boundary calculated for a flow coming from an idealized nozzle. Also, the circulation flow is calculated. A proof is given of the equivalence of the two equations

$$\operatorname{curl}[\mathbf{v} \times \mathbf{H}] = 0 \text{ and } |\mathbf{H}| = \text{const}\,\rho$$

for a two-dimensional steady flow. E.E.B.

N65-31848# Warner and Swasey Co., Flushing, N. Y.
SPECTROSCOPIC STUDIES OF ARGON AND NITROGEN PLASMAS AT REDUCED PRESSURE. TEMPERATURE DISTRIBUTIONS IN PLASMAJETS AND WALL-STABILIZED ARCS
Lothar Klein and Harold J. Babrov Dec. 1964 48 p refs
(Contract AF 33(615)-1178)
(AD-463732)

Stationary plasmas at reduced pressure (0.02 – 0.1 atm.) were studied by two different experimental approaches, the plasmajet and the wall-stabilized arc. The nitrogen plasmajet at low pressure is characterized by the appearance of a shock front (Mach disc) and exhibits pressure and temperature gradients. A method based on the atomic Boltzmann plot in absolute intensity units was used to obtain both the pressure and the temperature distribution. A wall-stabilized arc device with wide confining channel proved to be well suited for obtaining a high current (250 A), low pressure (0.1 atm) argon arc. Core temperatures above 16,000° K were determined and a high degree of ionization observed. The absence of pressure gradients makes the modified well-stabilized arc a useful tool for research at reduced pressure, but problems of arc stability and symmetry remain to be solved. The wavelengths of several new lines in the argon and nitrogen spectrum were determined, and a strong triplet in the near ultraviolet could be classified as belonging to the transition $3s^2P$ to $5p^2D^\circ$ of N I. Author

N65-31903# Aix-Marseilles Univ. (France). Institut de Mechanique des Fluides.
SYMPOSIUM ON LOW-TEMPERATURE PLASMA, MOSCOW, 15–18 JULY 1965
H. Guénoche, M. Billiotte, G. Inglésakis et al [1965] 39 p refs

Electrical conductivity of the plasma immediately behind the shock wave was measured in experiments with argon gas in a shock tube. It was found that when the filling pressure is greater than 3 mm Hg, the results agree with theoretical values calculated under the assumption that the plasma is in thermodynamic equilibrium. Studies of phenomena associated with the electrodes in shock tubes are also reported.
Transl. by J.M.D.

N65-31913# Commissariat à l'Energie Atomique, Fontenay-aux-Roses (France).
STABILITY OF PLASMAS OBTAINED IN EPPE [STABILITE DES PLASMAS OBTENUS DANS E.P.P.E.]

J. Adam, P. H. Rebut, and A. Torossian Brussels, EURATOM, 1965 33 p refs In FRENCH; ENGLISH Summary
(Contract EURATOM-007-62-1-FUAF)
(CEA-R-2713; EUR-2176.f) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 50 Belg. Fr.

The stability results obtained on Mest have been extended on a machine ten times more powerful : EppE. A plasma stable during its whole confinement time has been observed. This confinement time seems to be limited by the resistive diffusion of the magnetic fields through the plasma. Author

N65-31916# Commissariat à l'Energie Atomique, Fontenay-aux-Roses (France). Groupe de Recherches sur la Fusion Contrôlée.
MATHEMATICAL PRELIMINARIES FOR A STUDY OF WAVES IN A PLASMA [PRELIMINAIRES MATHEMATIQUES A UNE ETUDE SUR LES ONDES DANS LES PLASMAS]
M. Trocheris Brussels, EURATOM, 1965 39 p In FRENCH; ENGLISH Summary
(Contract EURATOM-007-62-1 FUAF)
(CEA-R-2743; EUR-2234.f) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 40 Belg. Fr.

This report contains the detailed proofs of mathematical results which are used in a study of the linear and "quasi-linear" approximation for "electrostatic" waves in a uniform plasma. Certain classes of functions of a complex variable, which are analytic in a strip parallel to the real axis, are defined and studied. In particular, properties of convergence of a sequence and of continuity with respect to a parameter are established for functions remaining inside one such class. The results are used to prove an existence theorem for the simplest equation in the quasi-linear theory of plasma waves. A number of elementary lemmas are used in the text and proved in an appendix.
Author

N65-31976# Princeton Univ., N. J. Plasma Physics Lab.
INVESTIGATION OF THE KELVIN-HELMHOLTZ INSTABILITY IN A CESIUM PLASMA
N. D'angelo and S. V. Goeler Jul. 1965 28 p refs
(Contract AT(30-1)-1238)
(MATT-352)

Experiments have been performed in a thermally ionized cesium plasma, in which a relative drift between ions in adjacent layers appears to excite the Kelvin-Helmholtz instability. The relative drifts required are of the order of the ion thermal velocity, or somewhat smaller. The frequency of the oscillations is generally in the range 1 to 4 kc/sec. A study has been made of the type of waves excited, by means of amplitude and phase measurements. Author

N65-31998# Minnesota Univ., Minneapolis. Plasma Physics Lab.
STUDY OF COLLISION PROCESSES IN GASEOUS PLASMAS
H. J. Oskam, ed. Jul. 1965 12 p
(Contract Nonr-710(37))
(SATR-4; AD-617386)

Progress is reported on the studies related to collision processes in gaseous plasmas. The results with respect to the ambipolar diffusion coefficient of He^+ and He_2^+ as obtained from mass spectrometer measurements are summarized. The studies related to the time dependence of the intensity of spectral lines and bands strongly indicated that the light emitted during the plasma decay period is not due to two-body recombination processes but is caused by processes involving three particles. Also, the results of mass spectrometric studies of diatomic molecular ions are summarized and the progress in the construction of the mobility mass identification tube is reviewed. E.E.B.

N65-32014# Argonne National Lab., Ill.
A STUDY OF CONVECTIVE MAGNETOHYDRODYNAMIC CHANNEL FLOW
Ralph M. Singer Mar. 1965 46 p refs
(Contract W-31-109-ENG-38)
(ANL-6967) CFSTI: $2.00

The steady, combined, free, and forced convective flow of an electrically conducting fluid through a vertical channel in the presence of a horizontal magnetic field was studied. Three distinct physical conditions were investigated: parallel-plate channel with walls of arbitrary electrical conductivity; rectangular channel containing a fluid with a very small magnetic Prandtl number; and rectangular channel with nonconducting walls. It was found that a magnetic field strongly inhibits free convection; a criterion was established that indicates when free convection may or may not be neglected. It was also observed that a magnetic field sufficiently flattens the velocity profile in a channel so that the flow can be considered one-dimensional in many cases. Also, a relationship between the Hartmann number and the aspect ratio is given which shows when the one-dimensional approximation can be made allowing a 5% error in calculating the ratio of the flow rate to the pressure gradient. E.E.B.

N65-32075*# Catholic Univ. of America, Washington, D. C. Dept. of Space Science and Applied Physics.
THE STABILITY OF SWIRLING FLOW OF A VISCOUS CONDUCTING FLUID IN THE PRESENCE OF A CIRCULAR MAGNETIC FIELD
Hsien-ping Pao May 1965 50 p refs */ts* Rept.-65-006
(Grants NsG-586; NSF G-19818)
(NASA-CR-64445) CFSTI: HC $2.00/MF $0.50 CSCL 20I

A sufficient condition for the stability of a swirling flow in a circular magnetic field is established. A stronger sufficient condition for stability is also given on physical grounds and by an approximate mathematical proof. Detailed results for small spacing between the cylinders are given. It is shown that the stronger sufficient condition for stability is exact for small spacings. A new branch of solution which corresponds to negative critical Taylor number is calculated. An approximate solution for a positive α_0 is also given. A rather striking phenomenon is that there is a case which the unstable circulatory flow field is counterbalanced by the unstable circular magnetic field such that the combined field makes a stable flow. The dual roles of viscosity and magnetic diffusivity and their physical mechanism are also discussed. Author

N65-32102# United Kingdom Atomic Energy Authority, Culham (England). Research Group.
MICROWAVE EMISSION FROM THE ZETA PLASMA
D. J. H. Wort Feb. 1965 28 p refs
(CLM-R-40) HMSO: 4s 6d

Simultaneous measurements of the thermal microwave noise emitted by the ZETA plasma at 2 mm and 4 mm wavelengths have been used, with simplifying assumptions, to deduce the plasma density and electron temperature as a function of time throughout the ZETA current pulse. Before peak current the plasma is turbulent, and parameters describing the turbulence are deduced. After peak current the plasma is quasi-uniform, although there is a steady loss of plasma. This loss appears to be arrested during a quiescent period, and at this time a partial cessation of turbulence leads to a change of density profile and improved containment. At low initial pressures the microwave results provide qualitative confirmation of spectroscopic measurements of pump-out and injection. A tentative model of the turbulence mechanism within the plasma is proposed, and it is found that the turbulent heat transfer is sufficiently great for the plasma to be roughly

isothermal. It is concluded that this new microwave technique can afford valuable information about the behaviour of the plasma. Author

N65-32113*# North Carolina State Coll., Raleigh. Dept. of Mechanical Engineering.
THEORETICAL STUDY OF NON-EQUILIBRIUM IONIZATION IN THE PRESENCE OF ELECTRIC AND MAGNETIC FIELDS Progress Report No. 3, 1 Feb.–31 Jul. 1964
H. A. Hassan [1964] 4 p refs
(Grant NsG-363)
(NASA-CR-58723) CFSTI: HC $1.00/MF $0.50 CSCL 20I

A one-dimensional analysis was used to predict the thrust from a coaxial plasma accelerator. The results of the analysis proved to be rather unsatisfactory because of the bulging of currents. As a result of bulging, E_x, the component of $\vec{E}$ in the direction of acceleration, changes sign, and no suitable average of E_x could be obtained which would bring out the important features of the acceleration mechanism. The one-dimensional analysis showed, that in regions not dominated by viscous stresses, the Hall effect was more important than conversion of rotation into directed motion as an acceleration mechanism. The thrust is due mainly to conversion of thermal energy into directed energy and to the Hall effect. R.W.H.

N65-32130# United Aircraft Corp., East Hartford, Conn. Research Labs.
[INVESTIGATION OF BASIC CONTAMINANT REACTIONS IN RE-ENTRY WAKES] Quarterly Letter Report No. 2
R. H. Bullis, V. E. Groh, R. K. Flavin, and T. L. Churchill 12 Oct. 1964 10 p refs
(Contract DA-31-124-ARO(D)-221; ARPA Order 553)
(C-920252-2; AD-461067)

Investigations of the reactions of alkali metal impurities with atmospheric constituents are reported. Progress is discussed for three different investigations: (1) electron cyclotron resonance techniques for the determination of electron number density and effective collision frequency of sodium hydroxide at 1000° to 1500° K; (2) electron attachment interactions with sodium hydroxide; and (3) total cross section of sodium ions interacting with various atmospheric constituents such as N_2, O_2, and NO. E.E.B.

N65-32134# Aerospace Corp., San Bernardino, Calif.
THEORY OF ELECTROSTATIC DOUBLE PROBE COMPRISED OF TWO PARALLEL PLATES
Paul M. Chung and Victor D. Blankenship Apr. 1965 51 p refs
(Contract AF 04(695)-469)
(TDR-469(S5240-10)-3; BSD-TR-65-383; AD-466979)

The difficulties with continuum single probes in plasma diagnostics may arise from the uncertainties surrounding the other electrode (ground), which usually does not assume the plasma potential at the point of interest, and from the fact that the probe disturbs the plasma to a much greater extent than that predicted by classical theories. In order to circumvent these difficulties, the present paper analyzes the double-probes comprised of two parallel plates. The governing equations for the electrical and flow properties of the continuum, weakly ionized plasma are solved. The cases of electron temperature in frozen state, with respect to the neutral gas temperature, and in equilibrium are considered. From the solution, simple equations are derived which can be used to translate the potential-current characteristics of the probe into the electron temperature and number density of the free stream plasma. The analysis also shows the detailed mechanism by which electricity is conducted between two plates across a flowing plasma. Author

N65-32142# Aix-Marseilles Univ. (France). Institute of Fluid Mechanics.
STUDY OF THE ACTION OF A MAGNETIC FIELD ON AN IONIZED GAS IN A SHOCK TUBE BY THE PASSAGE OF A PRIMARY SHOCK WAVE, STUDY A [ETUDE DE L'ACTION D'UN CHAMP MAGNETIQUE SUR UN GAZ IONISE DANS UN TUBE A CHOCS PAR LE PASSAGE DE L'ONDE DE CHOC PRIMAIRE, ETUDE A]
J. Valensi, P. Parraud, and G. Inglesakis [1965] 71 p refs In FRENCH

Experimental investigation of the interaction of the plasma flow and transverse magnetic field resulting from combustion of argon gas in a shock tube is reported. Transl. by J.M.D.

N65-32143# Aix-Marseilles Univ. (France). Institute of Fluid Mechanics.
STUDY OF NITROGEN VIBRATION RELAXATION BY REVERSAL OF SODIUM D LINES, STUDY B [ETUDE DE LA RELAXATION DE VIBRATION DE L'AZOTE PAR LA METHODE DE RENVERSEMENT DES RAIES D DU SODIUM, ETUDE B]
M. Alombert, B. Forestier, and H. Guenoche [1965] 58 p refs In FRENCH

A sodium D-line reversal method was applied to the measurement of the vibration relaxation temperature of nitrogen in a shock tube. The variation of relaxation frequency is also determined. Experimental results show that the electronic excitation of sodium is not in equilibrium with nitrogen vibration, and therefore the sodium line reversal method is not suitable for the study of gas vibration relaxation. Transl. by G.A.L.

N65-32154*# Michigan Univ., Ann Arbor. Radiation Lab.
ELECTRODYNAMICS OF MOVING AN ISOTROPIC MEDIA: THE FIRST-ORDER THEORY
C. T. Tai [1964] 22 p refs Submitted for Publication
(Grant NsG-444)
(NASA-CR-59289) CFSTI: HC $1.00/MF $0.50 CSCL 20C

Minkowski's theory of moving media is extended hereby to the anisotropic case. The corresponding Maxwell-Minkowski equations have been derived under the condition that the velocity of the moving medium is small compared to the velocity of light. The theory is applied to derive the characteristic equation for the index of refraction in a drifting magneto–ionic medium. The result verifies the previous one obtained by Epstein. Two different formulations based upon the convection current model and the polarization model are discussed in detail from the point of view of the transform method. Author

N65-32210# Aeronautical Research Labs., Wright-Patterson AFB, Ohio.
A BIBLIOGRAPHY ON MOVING STRIATIONS
R. S. Palmer and A. Garscadden Jun. 1965 35 p refs
(ARL-65-120; AD-619027)

N65-32214# AVCO-Everett Research Lab., Everett, Mass.
EXPERIMENTS ON MAGNETICALLY PRODUCED AND CONFINED ELECTRON CLOUDS
G. S. Janes Jun. 1965 13 p refs
(Contract AF 49(638)-659; AF 49(638)-1553)
(AMP-165; AD-619215)

Experimental evidence is given to show that a stable dense cloud of electrons with an associated negative electrostatic potential well can be produced inductively in cylindrical geometries. The electron cloud is produced by injecting electrons near the outer cylindrical wall while an axial magnetic field is rising. The electrons remain attached to the field lines on which they were injected, and are therefore moved towards the center

as the magnetic field lines converge. The equilibrium configuration, some empirical evidence regarding stability limits on the electron density, and the experimental verification of the basic inductive charging concept are discussed. Results suggest that both unstable and stable configurations exist and can be produced by this technique. C.T.C.

N65-32215# Physics, Engineering, Chemistry Corp., Boulder, Colo.

INVESTIGATION OF THE DYNAMICS OF IONIZED MEDIA (PLASMAS) Final Report

Wesley E. Brittin and Willard R. Chappell May 1965 133 p
(Contract AF 33(615)-1334)
(ARL-65-91; AD-619045)

A theory of transport phenomena in a nearly homogeneous system of interacting electrons and photons is developed. A hierarchy of equations is derived which couples the various particle and photon distribution functions. The hierarchy is truncated in a physically intuitive way so that a closed set of equations is obtained. The truncated set of equations is then solved, in various orders of approximation making use of the well-known Bogoluibov assumption concerning the rates of relaxation of correlations and distributions. There results a set of coupled equations for the particle and photon distributions. Terms in the resulting equations correspond to various physical processes such as shielded electron–electron scattering, bremsstrahlung, Thomson scattering, etc. In addition there occur some unexpected contributions. Author

N65-32245# Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.

EXPERIMENTAL MEASUREMENT OF THE GROWTH OF A TURBULENT MERCURY JET IN A COAXIAL MAGNETIC FIELD

Miklos Sajben and James A. Fay Jun. 1965 36 p refs *Its* Fluid Mech. Lab. Publ. No. 65-5
(Contracts AF 19(828)-221; Nonr-3623(S-2); Proj. Squid)
(AD-618299)

Using a hot wire system developed for this purpose, measurements of the velocity were made in a circular liquid mercury jet issuing into a low speed secondary flow and subject to a uniform axial magnetic field. The Reynolds number of the jet was about 10,000 while the magnetic interaction parameter varied from zero to slightly over one. The jet was strongly turbulent under all conditions investigated. The radial distribution of the mean and fluctuating component of the meridional velocity was measured at four axial stations located between 2 and 34 diameters from the nozzle exit. The results indicate that the rate of spreading of the jet is decreased, that the shape of the velocity profile changes and that the turbulent intensity decreases with increasing magnetic field strength. The high frequency components of the fluctuations in the secondary flow seem to be damped more strongly than fluctuations at low frequencies, while the reverse is observed within the core of the jet. Author

N65-32248# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.

STATISTICAL THEORY OF HOMOGENEOUS HYDROMAGNETIC TURBULENCE

Sayed D. Hassan Jun. 1965 99 p refs
(Grant DA-ARO(D)-31-124-G457)
(SUDAER-238; AROD-4284-4; AD-618326)

The existence of equilibrium ranges in homogeneous hydromagnetic turbulence is analyzed by using Fourier techniques. It is found that the reasons for believing in the existence of the equilibrium range in classical turbulence (non-conducting fluid) also hold for hydromagnetic turbulence. The presence of an external magnetic field has the effect of rendering the turbulence field axisymmetric about those magnetic lines. This effect is especially pronounced for small eddies for which the inference of the magnetic field is the greatest. However, if the Reynolds number is very high, other forces will become dominant over the external uniform magnetic field, and as a result isotropy can be achieved which will lead to the existence of a Kolomogroff-type kinetic equilibrium range. A similar situation will arise concerning the magnetic equilibrium range. The second problem considered is the asymptotic form of different correlation tensors at large separation distance in homogeneous hydromagnetic turbulence. The third problem we considered is a theory of weak turbulence where one can neglect the role of pressure forces in developing power laws, and thus we have analytic spectrums. Lastly, we considered the final period of decay. Author

N65-32280# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DISTRIBUTION OF THE PARTIAL PRESSURES OF NEGATIVE IONS IN THE POSITIVE COLUMN OF A LOW-PRESSURE DISCHARGE

A. M. Rezikyan, G. A. Galechyan, and V. V. Galechyan 9 Jul 1965 12 p refs Transl. into ENGLISH from Izv. Akad. Nauk Arm. SSR, Ser. Fiz.-Mat. Nauk (USSR), v. 17, no. 6, 1963 p 117–124
(FTD-TT-65-12/1+2+4; AD-618044)

The formation of negative ions in a positive gas column is considered, and the radial distribution of partial pressures of negative ions in the positive column is examined. Equations are derived that contain the dependence of pressure of the electrons on temperature. The previous work of Steenbek assumed that electron pressure was independent of the temperature and the present work shows that for values of the ratio T/t on the order of 30 or larger this assumption is valid. However, for values of the ratio near unity, the partial pressure of the electrons differs considerably from that obtained by Steenbek. The relationships obtained in this work cover the entire range of temperature ratios. E.E.B.

N65-32325# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France).

ANNULAR ELECTROMAGNETIC PUMPS, CONSTRUCTION AND TESTING, THEORY AND COMPARISON WITH EXPERIMENTAL RESULTS [POMPES ELECTROMAGNETIQUES ANNULAIRES, CONSTRUCTION ET ESSAIS, THEORIE ET CONFRONTATION AVEC L'EXPERIENCE]

Etienne Cambillard and Bernard Schwab Jul. 1964 49 p refs *In* FRENCH
(CEA-R-2523)

Fabrication of various parts for electromagnetic pumps with annular induction is described. The fabricated pumps were operated over long periods, and it was found that aluminum oxide can be used as a conductor and that it is possible to use an induction regulator. A method for calculation of pressure and loss coefficients is presented which takes into account operation of the magnetic circuit. Also, a method for computing the flux along the pump is given. Transl. by J.M.D.

N65-32345# Princeton Univ., N. J. Plasma Physics Lab.

THE EFFECT OF A TIME-VARYING TRANSVERSE MAGNETIC FIELD ON THE EQUILIBRIUM OF A TOROIDAL PLASMA

John O. Kessler and Rolf M. Sinclair Aug. 1965 12 p refs
(Contract AT(30-1)-1238)
(MATT-354)

We describe experiments in which a time-varying magnetic field, $B_T(t)$, was applied transverse to the main confining field of the Model C stellarator. The hydrogen plasma carried a toroidally-flowing current. We adjusted $B_T(t)$ to minimize the (time-varying) charge separation drift currents, and found

no improvement in plasma conditions compared to those obtained with a steady transverse field. We also found it possible to destroy the conditions of plasma equilibrium by a sudden application of $B_T(t)$. These results are in agreement with previously-discussed theoretical conditions for equilibrium of toroidal plasma. Author

N65-32359# Princeton Univ., N. J. Plasma Physics Lab.
ROTATING PLASMA EXPERIMENTS IN THE B-3 STELLERATOR
J. G. Gorman and L. H. Th. Rietjens Aug. 1965 54 p refs
(Contract AT(30-1)-1238)
(MATT-342)

A radial electric field can be imposed on the plasma column of a stellerator by means of a comparatively large, positively biased Langmuir probe. Measurements are presented which confirm the theoretical description of the resulting $E \times B$ rotation interms of a leaky plasma capacitor; the leakage is caused most likely by resonant charge exchange collisions with neutral atoms. The plasma loss rate is changed in the rotating region; a decrease in loss rate by a factor 8 can be realized; too large a rotational velocity causes the loss rate to increase again. Comparisons are made with other experiments and theories. Author

N65-32382# Princeton Univ., N. J. Plasma Physics Lab.
PLASMA HEATING AT 500 MEGAHERTZ
Robert A. Ellis, Jr. and Barry J. Rye Jun. 1965 34 p refs
(Contract AT(30-1)-1238)
(MATT-332)

The production and heating of deuterium and helium plasmas in the B-3 stellerator by a 25 kW 500 MHz generator are investigated. The efficiency for plasma production by rf is found to be comparable with ohmic heating at similar power levels. The confinement of the plasma produced is in order of magnitude agreement with the Bohm formula as well as the predictions of the so-called lack of equilibrium theory. Measurements were also obtained at mW power levels in order to identify the plasma wave interaction involved. Although data are not conclusive, the plasma generation and heating at ion densities greater than 10^{12} cm^{-3} are tentatively attributed to collisional damping of the whistler mode. The range of conditions included the lower hybrid resonance but there was no experimental evidence for this resonance. An interesting feature of the wave propagation was the observation of a sharp onset of wave propagation around the stellerator for densities less than some critical value. Some possible explanations for this phenomenon are presented. Author

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N65-31282 Joint Publications Research Service, Washington, D. C.
THE EFFECT OF FINE SPLITTING OF THE LOWER LEVEL OF Cr^{+3} IN RUBY ON CERTAIN CHARACTERISTICS OF COHERENT RADIATION
G. I. Freydman *In its* VUZov: Radiofiz., Vol. VIII, No. 2, 1965 10 Aug. 1965 p 70-86 refs (See N65-31275 20-23) CFSTI: $6.00

The author obtains abbreviated equations describing the coherent radiation of excited chromium ions in ruby in a traveling-wave resonator with allowance for fine splitting of the lower level of the chromium ion. It is shown that this splitting leads to a change in the mean radiation frequency during the transition process. Author

N65-31294 Joint Publications Research Service, Washington, D. C.
THE THEORY OF ELECTRON-HOLE JUNCTION
L. V. Postnikov and T. M. Tarantovich *In its* Izv. VUZov: Radiofiz., Vol. VIII, No. 2, 1965 10 Aug. 1965 p 222-232 refs (See N65-31275 20-23) CFSTI: $6.00

The method of a small parameter is used for finding the approximate solution to a system of differential equations in partial derivatives describing the electron-hole junction. The operator relationship between the current through the n-p junction and the voltage impressed across it is obtained. For sufficiently low frequencies, the operator relationship reduces to an ordinary nonlinear differential equation. Author

N65-31302 Joint Publications Research Service, Washington, D. C.
ENERGY LEVELS AND RELATIVE LINE INTENSITIES OF NUCLEAR QUADRUPOLE RESONANCE FOR CERTAIN INTEGRAL SPINS
N. Ye. Aynbinder and V. S. Grechishkin *In its* Izv. VUZov: Radiofiz., Vol. VIII, No. 2, 1965 10 Aug. 1965 p 267-272 refs (See N65-31275 20-23) CFSTI: $6.00

Relative line intensities of nuclear quadrupole resonance are shown as a function of the value of the asymmetric parameter for a spin of two. Data on energy level, eigen functions, field orientation, transition, and relative intensity are tabulated for spins of two and three. These data, which are valid for any monocrystal, permit the determination of asymmetric parameter and absorption line data. Many radioactive isotopes possess integral spins, and the calculation of energy level and relative intensity of nuclear transitions is applicable to investigating resonance absorption of Mossbauer effect. M.W.R.

N65-31436# California Univ., Livermore. Lawrence Radiation Lab.
AN AUTOMATIC CALIBRATION SYSTEM FOR MEASURING ELECTRICAL RESISTANCE AT HIGH PRESSURES
H. D. Stromberg and D. R. Stephens 13 Aug. 1964 8 p refs
(Contract W-7405-ENG-48)
(UCRL-7902, Rev. 1; Conf-763-1)

An improved method for measuring electrical resistance at high pressure is described. Bridgman anvils are employed. Two reference standards, either bismuth and barium or bismuth and tin, are run simultaneously with the unknown to obtain pressure calibration. The method is described and typical data obtained with lead and beryllium are shown. Author

N65-31438# California Univ., Livermore. Lawrence Radiation Lab.
DEVELOPMENT OF A LiF DOSIMETRIC MATERIAL
Donald Jones, James Gaskill, Alice Burt, and Seymour Block 15 Oct. 1964 22 p refs
(Contract W-7405-ENG-48)
(UCRL-12151; CONF-803-1)

Three procedures for fabrication of dosimetric material are described: (1) Diffusion Techniques—A furnace made of recrystallized alumina was built and used for diffusion doping. The LiF plus the residue of an aqueous solution of the specific cation dopants were placed in spectrographic-grade graphite crucibles and set into the furnace in an argon atmosphere. (2) Melt and Slow-Cool Technique—As the Mg + Eu combination of dopants provides desirable thermoluminescent properties, the glow curve temperatures and sensitivity of this combination were studied, when the dosimeter was fabricated as

a polycrystal. (3) Single-Crystal Technique—Parameter studies of LiF single-crystal growing with various mixtures of the most sensitivie dopants were conducted. R.W.H.

N65-31439# California Univ., Livermore. Lawrence Radiation Lab.
DIFFUSION IN MAGNETIC MATERIALS
R. J. Borg 20 Aug. 1964 10 p refs
(Contract W-7405-ENG-48)
(UCRL-12029-T; CONF-691-2)

Diffusion is considered in ferromagnetic metals and alloys near the Curie temperature. To determine the possible causes and magnitude of the departure from the customary linear relation between the log of diffusion and the Curie temperature, a reliable estimate was made of the nonlinear behavior with respect to temperature. Emphasis is on Fe, but diffusion of C in Co and Co rich Fe alloys is also examined. The magnetic effect is discussed in terms of absolute rate theory, and it is seen that both the decrease in vacancy concentration as well as the change in elastic properties are contributing factors with the latter dominant. C.T.C.

N65-31451 Pennsylvania Univ., Philadelphia.
THE STRONGLY COUPLED ELECTRON–PHONON SYSTEM IN NORMAL AND SUPERCONDUCTING METALS
J. R. Schrieffer *In* Maryland Univ. Proc. of the 3d Ann. Eastern U.S. Theoret. Phys. Conf. [1964] 7 p ref (See N65-31450 20-24)

A survey of recent experiments indicates a clear picture for strong couplings and p-band metals at temperatures below the melting point. While strong coupling effects appear to be well understood in both normal and superconducting metals, it is pointed out that the anistropy of the electron–phonon interaction is neglected. Also, the treatment of the Fermi surface as if it were spherical is a questionable procedure, particularly for lead where the Fermi surface is in contact with a zone boundary. M.W.R.

N65-31452 Bell Telephone Labs., Inc., Murray Hill, N. J.
THEORIES OF MAGNETISM IN METALS: SUMMARY
P. W. Anderson *In* Maryland Univ. Proc. of the 3d Ann. Eastern U.S. Theoret. Phys. Conf. [1964] 4 p refs (See N65-31450 20-24)

Magnetism in metals, particularly the 3-D metals Cr through Ni, is considered one of the unsolved problems in many-body theory. It is pointed out that recent experimental results have verified the existence of spin waves as the collective excitations which control behavior of ferromagnets at low temperatures; other measurements have proved that the d-electrons responsible for magnetism are itinerant and obey the usual band theory at low temperatures. These measurements provide information on two parameters, exchange stiffness and exchange splitting, of any future theory of magnetism; and band data provide details on structure of the energy bands of d-electrons. Two approaches to the theory are taken. Some researchers take a purely itinerant model and make calculations as if the d-electrons belonged to an ordinary parabolic band split by an exchange splitting, with modified effective mass and screened interaction parameters. The other approach, connected with magnetic alloys, observes that local magnetic moments often form on d-electrons in otherwise nonmagnetic alloys. M.W.R.

N65-31454 General Electric Co., Schenectady, N. Y. Research Lab.
A SOLVABLE TWO-LEVEL CROSSING PROBLEM
C. B. Duke *In* Maryland Univ. Proc. of the 3d Ann. Eastern U.S. Theoret. Phys. Conf. [1964] 8 p refs (See N65-31450 20-24)

Analysis of a two-level crossing problem, which is considered of intrinsic interest both for its analytical simplicity and its interpretation as a solvable time-dependent scattering problem, is presented within the framework of magnetic breakdown in solids. An equation is given to calculate the wave function at all values of time in the case of a two-body scattering problem; and asymptotic transition amplitudes for "scattering" and "no scattering" are found by two additional equations. In the adiabatic limit, $\lambda \to 0$, the particle scatters with certainty and remains in the state with highest energy. In the sudden limit, $\lambda \to \infty$, the system remains in its initial configuration. Because on1 the $|y| \to \infty$ solutions are necessary in the scattering boundary-value problem which can be solved by Laplace's method, it is hoped that this might be solved exactly by simple analytic continuation of the asymptotic results about the point at infinity. M.W.R.

N65-31486# Philco Corp., Blue Bell, Pa. Applied Research Lab.
A FUNDAMENTAL STUDY OF EPITAXY BY FLASH EVAPORATION Final Report, 1 Oct. 1964–30 Mar. 1965
John L. Richards 30 Apr. 1965 82 p refs
(Contract AF 19(628)-2937)
(AFCRL-65-412; AD-618909)

The crystalline nature and crystal quality of films of seven of the III-V compounds deposited onto Ge, CaF_2, and GaAs substrates have been studied with reference to changes in such parameters as evaporator and substrate temperature, lattice mismatch with substrate, and substrate orientation. Conditions have been determined for the preparation of epitaxial films. Films of mixed semiconductor systems can be deposited by the flash evaporation of mixed powders. The miscibility between compounds formed from the constituents Ga, In, P, As, Sb, has been studied. Using the method of flash evaporation of mixed powders, films of all of the quasi-binary systems possible were prepared, and the lattice constants and phase relationships within these films were determined using X-ray, electron diffraction and optical absorption techniques. The germanium–germanium epitaxial system has been studied so that certain parameters involved in "in situ" doping by flash evaporation could be determined more readily. An investigation has been made of the direct and indirect epitaxy of compound semiconductors on mica substrates. Author

N65-31545# Hanford Atomic Products Operation, Richland, Wash.
ELASTIC CONSTANTS OF SINGLE CRYSTAL UO_2 AT 25°C
J. B. Wachtman, Jr., M. L. Wheat (Natl. Bur. of Standards), H. J. Anderson, and J. L. Bates 1 Nov. 1963 9 p refs Prepared jointly with the Natl. Bur. of Standards
(Contract AT(45-1)-1350)
(HW-SA-3241)

The elastic constants of single crystal UO_2 at 25° C were determined to be $c_{11} = 3.95 \pm(.01s)$, $c_{12} = 1.21 \pm(.019)$, and $C_{44} = 0.641 \pm(.0017)$ in units of 10^{12} d/cm^2. The numbers in parentheses are computed standard errors of the corresponding constants based on about 16 measurements of each transit time required in four independent determinations of the set of three elastic constants. Author

N65-31692# Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
RESEARCH AND DEVELOPMENT FOR SEMICONDUCTOR SURFACE CONTROL AND STABILIZATION Final Report, Nov. 1963–Feb. 1965
Ki Dong Kang, E. D. Metz, C. Lund, J. Adamic, F. Lee et al 14 Mar. 1965 113 p refs
(Contract AF 19(628)-3808)
(AFCRL-65-361; AD-466166)

Studies were made of certain surface effects on silicon device parameters. These studies can be categorized as falling in three broad areas: the oxide-ambient gas interface, the oxide-semiconductor interface, and the oxide itself. Topics included in this investigation were: gross chemical contamination of oxide surfaces, oxide defects generated during manufacture of devices, interface distributions and gettering of metallics, modulation of surface electron density in MOS devices, and gamma-ray irradiation effects on conventional and MOS silicon devices. Elucidation is made of surface phenomena occurring in all these areas which might be consequential in the control and stabilization of semiconductor surfaces. Author

N65-31706# Rutgers Univ., New Brunswick, N. J.
PROPERTIES OF SUPERCONDUCTING ALLOYS CONTAINING PARAMAGNETIC IMPURITIES
S. Skalski, O. Betbeder-Matibet, and P. R. Weiss [1964] 68 p refs Sponsored by NSF and ONR
(AD-617362)

Effects of paramagnetic impurities in superconductors have been studied and the density of states in energy have been computed for different values of the inverse collision time for exchange scattering. Calculations indicate that the essential feature of superconductivity is the correlation of the electrons rather than a gap in the excitation energy spectrum. It is shown that even in the absence of a gap, there is an ordered state below a certain critical temperature which displays usual superconductor properties as long as the correlation persists. The temperature dependent order parameter has been computed for different exchange scattering values. Critical field and discontinuity in specific heat at the critical temperature are calculated. Expressions for penetration depth and complex conductivity are obtained and numerical results are presented for zero temperature. An equation is derived for the total energy. M.W.R.

N65-31707# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DESIGNING A 4-CONTACT METHOD FOR MEASURING THE SPECIFIC ELECTRIC CONDUCTIVITY OF THIN SEMICONDUCTOR FILMS
Yu P. Kozhevnikov 1 Jul. 1965 7 p refs Transl. into ENGLISH from Izv. Vysshikh. Uchebn. Zavedenii, Fiz. (Tomsk), no. 2, 1964 p 173–175
(FTD-TT-65-668/1+2+4; AD-617677)

A formula is obtained for measuring specific electric conductivity of thin semiconductor films which couples the electric conductivity of the film with the potential difference between the measuring contacts, the current strength, the film thickness, and the geometric parameters of the contacts. This formula is derived by solving the equation for the potential which describes the electrical field giving rise to the current in the film. M.W.R.

N65-31734# Oak Ridge National Lab., Tenn.
COMPARISON OF THE THERMAL CONDUCTIVITY, ELECTRICAL RESISTIVITY, AND SEEBECK COEFFICIENT OF A HIGH-PURITY IRON AND ARMCO IRON TO 1000°C
J. P. Moore, W. Fulkerson, D. L. Mc Elroy, and T. G. Collie 6 Oct. 1964 24 p refs
(Contract W-7405-ENG-26)
(ORNL-P-594)

The results of this study show Armco iron to be an excellent thermal conductivity standard below 910° C and that the temperature dependence of the thermal conductivity can be calculated to ±1.5% using electrical resistivity measurements. Also, the electrical resistivity increase due to impurities is not a constant, independent of temperature, as is the case for simpler metals. Instead, the change in electrical resistivity increases with temperature to the Curie point above which it is constant. The electrical resistivity drop at the α-γ transformation was larger for high-purity iron than for Armco iron. Cold working of iron by swaging appears to increase the resistivity by a substantial amount and the effect is temperature dependent with a maximum near the Curie temperature. The Seebeck coefficient of iron is sensitive to impurity content below 550° C and increases with impurity content. The Seebeck coefficient exhibits a minimum near 440° C and undergoes a 43% decrease at the α-γ transformation. E.E.B.

N65-31735# Sandia Corp., Albuquerque, N. Mex.
PULSE LIFE AND DIELECTRIC STRENGTH OF A GLASS-FILLED EPOXY RESIN SYSTEM
Lee J. Seligman [1964] 6 p ref
(Contract AT(29-1)-789)
(SC-DC-64-1003)

The appearance of dendritic tree growth, which precedes catastrophic failure of a dielectric in a non-uniform electric field, indicates that the presence of high-strength inclusions might hinder this growth and so increase the pulse life and dielectric strength of the material. This concept was tested using an epoxy host material in the form of spherical glass particles. The spheres varied in size from about 350μ inches to 0.65 inches and were composed of such glasses as standard soda-lime and 17% borosilicate. A crushed silica powder was also used. The dielectric system was a clear polyol-modified, acid anhydride-cured epoxy resin. The introduction of the fillers appeared to increase the dielectric strength and reduction in filler packing density increases pulse life, apparently by reducing the incidence of contact between filler particles. E.E.B.

N65-31758# Institutt for Atomenerg., Kjeller (Norway). Netherlands' Norwegian Reactor School.
ADVANCED COURSE ON MAGNETIC EXCHANGE INTERACTIONS IN TRANSITION METAL COMPOUNDS
A. F. Andresen, E. F. Bertaut, E. Frikkee, F. Grovold, R. D. Lowde et al Sep. 1964 136 p refs
(KR-93)

Discussed are the following aspects of the Heisenberg magnetic exchange interactions in transition metal compounds: ordering schemes in magnetic substances; different theoretical and experimental methods used to gain quantitative information on the exchange interactions; magnetic moments or spins in the crystal lattice, and their location, magnitude, and direction; semiempirical rules of spin ordering, and diffraction experiments related to covalency; and the lattice theory of spin configuration. G.G.

N65-31782# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy).
PERSISTENT CURRENTS INDUCED BY A POLARIZED WAVE IN A SUPERCONDUCTING RING [CORRENTI PERSISTENTI INDOTTE DA UN ONDA POLARIZZATA CIRCOLARAMENTE IN UN ANELLO SUPERCONDUTTORE]
C. Guaraldo, G. Sacerdoti, and A. Susanna 7 May 1965 11 p refs In ITALIAN
(LNF-65/15)

An experiment dealing with the kinetics of a superconducting ring, and a possible technique for determining the quantity of elementary flux in a superconducting ring are presented. The experimental system consists of a circularly polarized wave

interacting with electrons and superconducting electrons. Numerical calculations for the flux, as well as a description of the experiment are given. Transl. by G.A.L.

N65-31805# Cornell Univ., Ithaca, N. Y.
THEORY OF THE THERMAL CONDUCTIVITY OF SUPERCONDUCTING ALLOYS WITH PARAMAGNETIC IMPURITIES
Vinay Ambegaokar and Allan Griffin 25 Aug. 1964 44 p refs *Its* Rept.-249
(Contract AT(30-1-2391)
(NYO-2391-2)

The electronic thermal conductivity (K_S) of a weakly coupled, isotropic superconductor doped with a small concentration of paramagnetic impurities is computed. The theory of such superconducting alloys has been given by Abrikosov and Gor'kov, and is based on the assumption that the static magnetic impurities are randomly distributed and that their spins are uncorrelated. Starting from a Kubo formula, K_S is calculated by considering the electron-impurity interaction in the ladder approximation. A considerable simplification of the final expression for K_S obtains if the exchange scattering time t_S is much larger than the total scattering time. Numerical calculations have been made of the ratio of the thermal conductivity in the superconducting and normal states as a function of the reduced temperature (T/T_c) for different impurity concentrations. Author

N65-31815# Westinghouse Electric Corp., Pittsburgh, Pa. Westinghouse Research Labs.
TRANSPORT STUDIES OF DEFECT STRUCTURE INORGANIC COMPUNDS Final Technical Report, 30 Sep. 1964–31 Mar. 1965
[1965] 34 p
(Contract Nonr-3800(00); ARPA Order 300)
(AD-464733)

Research on oxygen–ion conducting electrolytes and chemisorption studies are summarized and abstracts are presented of the projects completed. The solid electrolyte studies were made on oxides based on three related crystal structures: the fluorite, the pyrochlore, and the c-type rare earth. Addition of a few mole percent Y_2O_3 or CaO to ThO_2 or ZrO_2 at 1300° C or below resulted in the substitution of Y^{+3} or Ca^{+2} for Th^{+4} or Zr^{+4} in the crystal and an appropriate number of vacancies at oxygen ion sites to preserve electrical neutrality. Thoria system at oxygen pressures below about 10^{-7} mm have lower conductivities but similar thermal emf characteristics to calcium or yttrium oxide doped zirconia with O^{2-} being the principle charge carrier. In the pyrochlore structures studied, $Cd_2Nb_2O_7$ and $Pb_{1.5}Nb_2O_{6.5}$ and solid solutions of these, metal interstitials occur with mixed ionic-electronic properties. Yttrium and scandium oxides have the c-type rare earth structure and with one exception will not form appreciable solid solutions with the alkaline earth oxides. Scandium oxide at about 2150° C will form a solid solution with 20 to 30% magnesium oxide. E.E.B.

N65-31892# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DEFINITION OF CERTAIN PARAMETERS OF SEMICONDUCTOR MATERIALS WITH HELP OF IRRADIATED OF p-n JUNCTIONS BY ELECTRONS
A. Shalpykov and Ye. M. Lobanov 13 Jul. 1965 7 p refs Transl. into ENGLISH from Izv. Akad. Nauk Uz. SSR, Ser. Fiz. Mat. Nauk (Tashkent), no. 6, 1961 p 80–81
(FTD-TT-64-1159/1+3+4; AD-295819)

Silicon photocells with a barrier layer were exposed to an electron beam to study the dependence of the current of the irradiated photocell on the energy of the electrons during the change in beam intensity from 0 to 30 Kev. In particular, the photocell samples were single crystals of p-type silicon with p-n junctions obtained by thermal diffusion of phosphorus from a gaseous environment. When the current intensity of the primary electron beam increased from 0 to 20 μa, a linear increase in the short circuit current of the photocell was observed. The data are used in determining values for the average ionizing energy for silicon and for certain recombination constants. J.M.D.

N65-31910# Laboratoires du Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).
AN ELECTRON MICROSCOPIC INVESTIGATION OF PHENOMENA ASSOCIATED WITH SOLID SOLUTION OF OXYGEN IN NIOBIUM
J. Van Landuyt 1965 18 p refs
(Contract EURATOM-082-62-7 RDB)
(EUR-2022.e) Available from Belg. Am. Bank and Trust Co. New York, Account No. 22.186: 25 Belg. Fr.

A transformation process in the solid solution of oxygen in niobium is studied by means of electron microscopy and diffraction. Several stages of the process have been found by treating the thin foils in the electron microscope and in a furnace under reduced pressure of air. Irregular-shaped nuclei were observed in the same study, having a superstructure of the niobium lattice. The lattice spacing corresponds to twice the niobium spacing. During this study one of the sub-oxide phases, NBO_x was observed as platelets growing in <110> directions on a (111) foil. This sub-oxide phase was epitaxially related to the niobium lattice. It is supposed that all the phenomena observed represent an intermediate stage in the transformation to the sub-oxide and oxide phases of niobium. Author

N65-31911# Laboratoires du Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).
PHYSICAL PROPERTIES OF UO_2 SINGLE CRYSTALS Second Year of Study
S. Amelinckx, H. Blank, J. Bressers, R. De Batist, R. De Coninck et al 1965 56 p refs
(Contract EURATOM-010-63-3 TEEB)
(EUR-2024.e) Available from Belg. Am. Bank and Trust Co. New York, Account No. 22.186: 85 Belg. Fr.

A simple and reliable method allowing the variation of composition (in the range UO_2–$UO_{2.25}$) has been developed. A device for the removal of plane-parallel layers of 0.3 micron thickness has been constructed (study of U self-diffusion). A new method for preparing thin UO_2 foils suitable for transmission electron microscope observations has been applied. The thermoelectric power of UO_2 crystals with different oxygen excess has been measured as a function of the temperature (100° to 300° K). The electrical conductivity of UO_2 crystals has been determined after successive periods of reactor exposure. A theoretical study of the validity of the Lee, Low and Pines method in the case of interaction of an electron with a single lattice oscillator has been made. The thermal conductivity of a UO_2 single crystal presenting a slight oxygen excess has been measured between 4° and 300° K. The elastic constant has been determined in one direction using a pulse echo technique. Author

N65-31962# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
PHYSICAL ACOUSTICS
K. U. Ingard et al Repr. from *Its* Quart. Progr. Rept. No. 77, 15 Apr. 1965 p 87–89 refs
(Contracts DA-36-039-AMC-03200(E); Nonr-1841(42))
(AD-616556)

Progress is reported on the response of lead zirconate titanate ceramics to temperature fluctuations; spontaneous instability in parallel flows; dispersion relation for ultrasound in

gyrotropic quantum plasma; and diffusion waves. Among the specific investigations discussed was the construction of lead zirconate titanate ceramics are pressure transducers. Three particular configurations were tested. Results obtained with transducers in the shock tube are reported; calibration made with a hot-air jet and a mechanical chopper wheel is described; and sample waveforms produced by spoken digits are shown. Also, the Feynman diagrammatic technique was used in a study of the causal aspects of the problem of ultrasonic absorption in simple metals in a static magnetic field. The dispersion relation for the scattering of phonons from electrons in a magnetic field was derived. E.E.B.

N65-31970# Delaware Univ., Newark. Dept. of Physics
[VOLUME PHOTOELECTRIC EFFECT IN METALS. CHARACTERISTIC ENERGY LOSSES IN LAYERED METALLIC THIN FILMS. A MODIFIED FARADAY CAGE] Final Report, 1 Feb. 1964–31 Jan. 1965
N. N. Axelrod [1965] 46 p refs
(Contract Nonr-2285(05))
(AD-617521)

The photoelectric currents from freshly prepared metal films have been compared with photocurrents of the same metal exposed to air in the spectral region of the volume photoelectric threshold. The fresh films were evaporated onto air exposed films with initial pressures in the low 10^{-8} region, and pressures during evaporation in the 10^{-6} to 10^{-7} torr region. Using the data of Walker, Rustgi, and Weissler, photoelectric yields per incident photon were obtained for fresh films of aluminum, bismuth, and indium. The steep slope in the photoelectric yield per incident photon as a function of wavelength, usually found in air exposed evaporated films, films evaporated at higher pressures than reported here, and bulk samples, and interpreted as the onset of the volume photoelectric effect, almost disappears for the fresh films, but reappears when air is admitted into the chamber. Author

N65-31992# Aberdeen Proving Ground, Md. Ballistic Research Labs.
ELECTRON TRANSIT IN AgBr AT 85°K
John D. Knapton Mar. 1965 13 p refs
(BRL-1277; AD-616523)

Some of the factors which can affect the transit of a pulse of electrons across a Bridgman AgBr crystal at 85° ±2° K were studied. The factors studied include the electron drift mobility (μ), electron trapping, and electrode charge injection. A fast pulse (5 nanosec) electron beam system was used for the excitation source. The value for μ, in substantial agreement with the work of Chollet and Rossel, was found equal to 389 ±12% cm^2/vsec. This value indicates that the scattering mechanism is primarily by longitudinal optical vibrations. Three different methods were used for determining μ: (1) measuring the rise time of the integrated charge associated with the electron pulse motion, (2) measuring the duration of the electron current pulse, and (3) fitting the integrated charge to a uniform trapping theory. Agreement was obtained between the three methods. Evidence is presented for an electron emission process possibly caused by shallow trapping. No evidence for electrode charge injection was found. Author

N65-32034*# Denver Research Inst., Colo.
[THEORETICAL STUDIES ON THE RELATIONSHIPS BETWEEN THE THERMIONIC WORK FUNCTION OF REFRACTORY INTERMETALLIC COMPOUNDS AND THEIR ELECTRONIC AND CRYSTAL STRUCTURES] Progress Report, 1 Jan.–30 Jun. 1965
C. Samuel Miller and Jerry D. Plunkett 30 Jun. 1965 9 p refs
(Grant NsG-365)
(NASA-CR-64581) CFSTI: HC $1.00/MF 0.50 CSCL 20L

Measurements of the thermionic work functions of the five intermediate phases to discover what relationships may exist between the work functions and the electronic and crystal structures are under study. A diode having a pure tungsten filament was prepared for checking the equipment and procedures used in the determination of the work function. The diode characteristics were determined by measuring the current as the electric field was increased by increments from 0 to 3700 V/cm. Measurement of the current-voltage characteristics of three satisfactory diodes at various temperatures was accomplished, and Schottky plots were constructed to obtain the zero-field values. R.W.H.

N65-32063# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF CREATING p-n TRANSFERS
I. I. Patalakh, I. M. Kustanovich, and L. S. Polak 2 Jul. 1965 6 p Transl. into ENGLISH from Russian Patent no. 161074 (Appl. no. 798839/26-9 15 Oct. 1962) 1 p
(FTD-TT-65-237/1+4; AD-617684)

A method is proposed for the preparation of p–n junctions on organic and inorganic polymer semiconductor materials. The surface of the polymer is cleared of adsorption substances and an electrode is applied in such a manner that the surface of the semiconductor material is protected from adsorption. After application of the electrode, a substance which has a reverse volumetric type of conductivity is adsorbed onto the specimen. An ohmic contact is then applied to the surface with the opposite type of conductivity. E.E.B.

N65-32068# Army Electronics Labs., Fort Monmouth, N. J.
EVALUATION OF SINGLE-CRYSTAL PLANAR HEXAGONAL FERRITES FOR APPLICATION TO MICROWAVE DEVICES
Samuel Dixon, Jr., John Bruscella, Arthur Tauber, and Robert O. Savage Apr. 1965 24 p refs
(ECOM-2585; AD-618386)

After several years of research and development, single crystals of ZnY ($6Ba_2Zn_2Fe_2O_3$), modified by substituted manganese, have yielded crystals with a resonance linewidth of 3.8 oersteds at 9.0 kMc and room temperature. This represents the lowest value reported for planar, hexagonal ferrites. From the observed threshold field, a spin-wave linewidth (ΔH_k) of 1.24 oersteds has been calculated. An experimental subsidiary resonance limiter at 17.2 kMc has been designed and its characteristics are being evaluated using Mn–ZnY crystals. At K_u-band frequencies and above, d-c magnetic field requirements are smaller for Mn–ZnY than for yttrium–iron–garnet (YIG), permitting a smaller, lighter device. Author

N65-32070# Rensselaer Polytechnic Inst., Troy, N. Y.
INVESTIGATION OF TRANSIENT RADIATION DAMAGE IN SEMICONDUCTOR MATERIALS Eighth Quarterly Progress Report, 1 Nov. 1964–31 Jan. 1965
Roland M. Lichtenstein, H. James Willard, Jr., and John C. Corelli Ft. Monmouth, N. J., Army Electron. Lab., [1965] 19 p
(Contract DA-36-039-AMC-02165(E))
(AD-618494)

Transient radiation damage effects in high purity p-type silicon due to 50 MeV electrons were observed. Roughly equal changes in magnitude and decay time of photoconductivity occurred; 30 to 60% of these changes annealed out within the first few minutes after the electron pulse. Author

N65-32071# Air Force Cambridge Research Labs., Bedford, Mass.
INFRARED SPECTRA OF CRYSTALS

Peter J. Gielisse and Shashanka S. Mitra Jun. 1965 99 p refs *Its* Phys. Sci. Res. Papers No. 109
(AFCRL-65-395; AD-618563)

The infrared absorption and reflection in a crystal due to the interaction of the incident electromagnetic field with its vibrational modes are described in this article. The concept of normal vibrations of a crystal is introduced by the example of a linear chain, and then is generalized to more complex 3-dimensional crystals. Methods of classifying unit cell modes by means of factor and site group analyses are pointed out. Dispersion of infrared radiation by an ionic crystal producing the reststrahlen spectrum is treated next, followed by the method of determination of optical constants from such a spectrum and also from attenuated total reflection and emission spectra. The role of $\vec{k} \neq 0$ modes, where $k = \frac{2\pi}{\lambda}$ represents the wave vector, in the interaction of more than one vibrational mode with the incident photon resulting in combination and overtone bands is discussed. Special emphasis is given on the optically active multiphonon processes in simple crystals. Examples are furnished by a discussion of the lattice infrared spectrum of AlSb followed by a comprehensive review of the multiphonon infrared absorption in diatomic cubic crystals. Infrared spectra of gypsum, $CaSO_4 \cdot 2H_2O$ and solid cyclopropane single crystals are described next as examples of more complex crystals.

Author

N65-32103# United Kingdom Atomic Energy Authority, Harwell (England).
THE MECHANICAL PROPERTIES OF BRITTLE SUBSTANCES
A. Smekal May, 1964 98 p refs Transl. into ENGLISH from Naturwissenschaften (Berlin), v. 15, 1936 p 106–188
(AERE-TRANS-1023)

Mechanical properties of glass are considered in a study of brittle substances, with macroscopic testing of Griffith's fracture theory of the isolated cleavage crack for a boundary case as a frame of reference. Crack surfaces of cylindrical glass parts are studied and compared with theoretical considerations; and fracture surfaces in the case of stress are studied. Ultimate tensile strengths of glasses are investigated in terms of surface condition, temperature-dependence, load, notch density, shape of cross section, and the surrounding medium. Influence of prior treatment of the glass is also considered. Theoretical foundations for such a study include discussions of surface energy and molecular tensile strength of homogeneous bodies, athermal bodies and different types of notches, and fracture limit and thermal motion. An appendix deals with the features found in anistropic material and their application to single crystals.

M.W.R.

N65-32138# Delaware Univ., Newark. Dept. of Physics.
CHARACTERISTIC ENERGY LOSSES IN LAYERED METALLIC THIN FILMS Technical Report, Feb. 1, 1964–Jan. 31, 1965
N. N. Axelrod [1965] 120 p refs
(Contract Nonr-2285(05))
(AD-617542)

The characteristic electron energy loss spectra of layered films of Bi and Mg were measured using a retarding potential electron energy analyzer with an electrically differentiated output to obtain the energy loss distribution directly. A new loss, not observed on single layer films of Mg or Bi, was found at 12.9 ±0.2 eV. This loss can be interpreted as a surface plasma loss at the metal–metal interface. A surface loss in Al–Mg films was not reproducible, but a new loss was observed at 26.4 eV which can be interpreted as a single Al loss at 15.4 eV plus a single Mg loss at 10.9 eV. Chemical and physical processes such as changes in composition and aggregation at the Al–Mg interface during both the preparation and measurement of the sample may alter the interface enough to decrease the intensity of the surface plasma loss.

R.N.A.

N65-32165*# Rice Univ., Houston, Tex. Dept. of Mechanical Engineering.
LOW TEMPERATURE ANNEALING OF THE ULTRASONIC ATTENUATION IN PRESTRAINED LiF AFTER Co^{60} GAMMA IRRADIATION AT LIQUID NITROGEN TEMPERATURE
Masaya Yabe [1963] 29 p refs Submitted for Publication
(Grant NsG-6)
(NASA-CR-59311) CFSTI: HC $2.00/MF $0.50 CSCL 20L

The effect of γ irradiation at liquid nitrogen temperature on the low temperature internal friction of compressed LiF crystals was studied by the ultrasonic pulse method at a frequency of 10 MC/S. The internal friction is substantially increased in compressed LiF crystals after a 5.8×10^6 r dosage of γ rays at 77° K. It was noted that this enhanced internal friction irreversibly decreases during uniform heating between 83° K to 110° K. The latter result is compared with the available data concerning annealing of electron spin resonance, optical absorption, and mechanical properties in the same temperature region. A new method of analyzing internal friction data to obtain the activation energy and jump frequency of the mobile pinning point defects is described. This was accomplished by measuring the internal friction while the specimen warmed up at a low linear rate because of the large heat capacity and low thermal conductivity of LiF. According to this analysis, the activation energy of migration of the H center in LiF is determined to be 0.103 ±0.004 eV.

Author

N65-32166*# Rice Univ., Houston, Tex.
DYNAMICAL PROPERTIES OF SOME RARE EARTH-INTERMETALLIC COMPOUNDS
Y. Kitano, F. Specht, and G. T. Trammell [1963] 11 p refs Submitted for Publication
(Grant NsG-6-59)
(NASA-CR-59318) CFSTI: HC $1.00/MF $0.50 CSCL 20L

The "band" structure which is discernable in the crystal level structure of the large J second half rare earth in cubic crystal fields is discussed. In the compounds which are considered the principal static and dynamic properties are determined by the properties of the low energy band. The spin waves in these substances consist of both longitudinal and transverse varieties, and expressions for their dispersion relations are obtained.

Author

N65-32169*# Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Nuclear Engineering and Science.
ANNEALING OF INFRARED DEFECT ABSORPTION BANDS IN 40 MEV ELECTRON-IRRADIATED SILICON
J. C. Corelli, G. Oehler, J. F. Becker, and K. J. Eisentraut [1964] 21 p refs Submitted for Publication
(Grant NsG-290)
(NASA-CR-59212) CFSTI: HC $1.00/MF $0.50 CSCL 20L

Oxygen containing n-and p-type silicon (100Ω–cm) and floating-zone n-type silicon (0.1Ω–cm) were irradiated by 44 Mev electrons at 40° C to total integrated fluxes of $1-2\times10^{18}$ e/cm^2. The floating-zone silicon remained n-type (2500Ω–cm) after irradiation and exhibited infrared defect absorption bands at 1.8μ and were cooled to 85° K defect bands at 3.46 and 3.62μ appeared. The oxygen-containing silicon was n-type after irradiation with resistivity of $3\times10^5\Omega$–cm and exhibited bands at 11.6μ and 12μ in addition to the 1.8, 3.46 and 3.62μ bands. Isochronal annealing studies indicated that 1.8, 3.46 and 3.62μ bands anneal out together and are completely removed in all samples by heat treatment to 300° C. The 11.6 and 12μ bands do not begin to anneal out until a temperature of 300° C is reached and are completely gone at 400° C. At temperatures above 375° C a new band at 11.2μ appears only in oxygen-containing silicon having maximum intensity at 475° C and then disappears at 575° C.

Author

N65-32191*# General Dynamics/Electronics, Rochester, N.Y. Research Dept.
LASER MODULATION AT THE ATOMIC LEVEL Monthly Report No. 8, 1–28 Feb. 1965
E. G. Brock, F. C. Unterleitner, Y. C. Kiang, and J. F. Stephany 10 Mar. 1965 14 p ref
(Contract NASw-1008)
(NASA-CR-64436) CFSTI: HC $1.00/MF $0.50 CSCL 20L

Spectroscopic study of YAG:Nd^{3+} has continued, resulting in measurement of the temperature dependence of energy levels involved in laser emission. The separation of the levels of the $^4F_{3/2}$ state is found to be 84.5 ±0.1 cm^{-1}, independent of temperature. Integrated intensities of the eight fluorescent lines between 1.05 and 1.08μ have been measured between 180° K and 400° K. Apparent linear dependence of linewidth on temperature is noted, but is subject to refinement of data. Temperature dependence of laser threshold has been measured and is discussed on the basis of spectroscopic data. Author

N65-32216# Tyco Labs., Inc., Waltham, Mass.
INVESTIGATION OF THE EFFECT OF THE CHEMICAL BOND ON THE ELECTRONIC PROPERTIES OF MULTICOMPONENT SEMICONDUCTORS Final Report, 1 Jun. 1962–31 May 1965
Arthur J. Rosenberg and Fritz Wald Bedford, Mass., AFCRL [1965] 42 p refs
(Contract AF 19(628)-1615)
(AFCRL-65-433; AD-619166)

An investigation was made of the effects of nonisomorphic alloying on the electronic properties of semiconductors of the IV-VI type with sodium-chloride structures. These experiments were conducted in conjunction with a theoretical concept, the "Chemical Approach to Semiconductors". Experiments were also directed towards the solution growth of the low temperature modification of boron, the red α-rhombohedral form which is of interest as a large energy gap elemental semiconductor. Detailed investigations on the solid solubilities of CdTe and In Te in PbTe and SnTe, as well as of CdSe and InSe in PbSe were carried out, and pertinent information on the resulting pseudo binary systems was collected. Selected alloys were measured for their electrical properties and the crystallographic and electrical information was used to gain a better understanding about the applicability and limitations of a chemical bond approach to compound semiconductors. The phase diagram of the boron-platinum system was determined and phase information on systems of boron with the elements of groups Ib and IIb and the heavier elements of groups IIIa, IVa, Va, and VIa was collected. Some experiments on the solution growth of the red-rhombohedral α-boron modification were carried out. Author

N65-32307# Texas Univ., Austin. Engineering Mechanics Research Lab.
CYCLIC DEFORMATION OF THIN FILMS INSIDE THE ELECTRON MICROSCOPE
F. H. Tuley and M. A. Wilkov Dec. 1964 18 p refs
(Grant AF-AFOSR-560-64)
(EMRL-RM-1001; AFOSR-560-64; AD-616263)

High purity silver and nickel films were obtained by vapor deposition onto a sodium chloride crystal in an ion pumped vacuum at a pressure greater than 10^{-9} Torr. Observations of the films in a Jem 150 electron microscope were made after floating the films off of the NaCl crystal and picking them up on a specimen grid while in the liquid. The electron micrographs showed dislocations, stacking faults and interference fringes present and that the films were not of uniform thickness. The results showed that metallic films could be obtained and that the attainment of films representative of the bulk material requires a refinement of the vapor deposition method under ultra-high vacuum conditions. A tensile device has been built to cyclically stress the films in the electron microscope and thereby study the motion of dislocations in the films and ultimately observe the fatigue crack. Author

N65-32343# California Univ., Livermore. Lawrence Radiation Lab.
EFFECTIVE FLUORESCENT LIFE TIMES IN RUBY LASER RODS
J. A. Fleck, Jr. 15 Apr. 1964 17 p refs
(Contract W-7405-ENG-48)
(UCRL-7765-T(Rev. 1))

In the presence of a population inversion fluorescent lifetimes are reduced as a result of stimulated emission. Effective fluorescent life-times have been calculated using a Monte Carlo method for ruby rods with Brewster angle ends and roughened sides. The calculations take into account the dependence of gain and reflectivity on polarization and the dependence of gain on frequency. Results show that effective fluorescent life-times are quite insensitive to rod length but strongly dependent on rod diameter. They also indicate the possibility of oscillation in a random mode for rods of sufficiently large diameter. Author

N65-32379# National Bureau of Standards, Washington, D. C.
CALCULATIONS FOR COMPARING TWO-POINT AND FOUR-POINT PROBE RESISTIVITY MEASUREMENTS ON RECTANGULAR BAR-SHAPED SEMICONDUCTOR SAMPLES
Lydon J. Swartzendruber 1 Jun. 1964 29 p refs
(ARPA Order-373-62)
(NBS-TN-241) GPO: $0.25

Fortran codes are given which enable the calculation of four-point probe correction factors for use with bar-shaped samples. Samples with either plated or unplated ends are considered. The errors that arise due to probe misplacement, inaccurate sample size and shape, and non-uniform end plating are also considered. Use of the results permits accurate comparison of two-point and four-point probe resistivity measurements. The codes are in Fortran II language and were written for an IBM 7090 computer. Author

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N65-31615# Purdue Univ., Lafayette, Ind. Jet Propulsion Center.
CONTINUOUS MEASUREMENT OF SOLID PROPELLANT BURNING RATES Final Report
J. R. Osborn, R. J. Burick, and R. F. Panella Jul. 1964 34 p refs
(Grant AF-AFOSR-207-63)
(JPC-386; F-64-3)

An experimental apparatus has been developed for the direct and continuous measurement of the burning rates of solid rocket propellants under conditions closely approximating those occurring in a solid rocket motor. The apparatus utilizes a positioning type servomechanism as a feed system which moves a sample of solid propellant within a two-dimensional rocket motor so that the receding burning surface of the sample is maintained at a fixed position with respect to the motor

walls. Because the burning surface is maintained at a fixed position; the measurement of the velocity of the propellant feed system is identical with the burning rate. The servomechanism incorporates a 50 millicurie cesium-137 source of gamma rays coupled with a scintillation probe for detecting the position of the burning propellant surface. A ratemeter is employed for converting the output of the probe into a voltage which is then amplified and compared to a standard voltage that is proportional to a desired position for the propellant surface. The resulting difference in voltage is amplified and drives a 0.6 hp servomotor which positions the burning surface of the propellant sample; the dimensions of the latter were approximately 1 inch square by 4 inches long. Author

N65-31686# Stanford Research Inst., Menlo Park, Calif.
VISCOELASTIC PROPERTIES OF SOLID PROPELLANTS AND PROPELLANT BINDERS Quarterly Technical Summary Report No. 2, 16 Dec. 1964–15 Mar. 1965
Nicholas W. Tschoegl, James R. Smith, and Thor L. Smith [1965] 29 p
(Contract NOw-65-0061-d; ARPA Order 22)
(Rept.-14; AD-465908)

The effect of specimen geometry and the magnitude of shear strain on the dynamic modulus of polyurethane propellant AEBA-10 was studied. A method was worked out to correct measurements to the same level of shear strain to allow a direct comparison under all experimental conditions. An evaluation of the differential Lissajous method for determining small phase angles has shown that, at frequencies as low as 0.05 cps, a phase angle of the order of a few thousandths of a radian can be measured with good precision. An evaluation was made of the static compressibility apparatus by determining the compressibility of dioctylsebacate at 25 and 50° C and at pressures up to 2000 psi. Author

N65-31691# Aerojet-General Corp., Sacramento, Calif.
SOLID PROPELLANT-LINER BONDING INVESTIGATIONS Quarterly Report, 1 Mar.–31 May 1965
C. Gustavson Jun. 1965 56 p refs
(Contract AF 04(611)-9959)
(Rept.-0907-81Q-3; AD-465547)

Variables governing the apparent bond strength of polybutadiene propellant systems, imine-cured carboxy-terminated polybutadiene (CTPB) and epoxy-cured polybutadiene-acrylic acid-acrylonitrile terpolymer (PBAN) were investigated. The effects of solvent-extractable mobile ingredients, and the effect of the substrate polymer type were studied. Variations of the propellant formulation were investigated. The influence of the oxidizer on the characteristics of the propellant binder adjacent to the substrate surface, and the effect of CTPB prepolymer fractions on bonding were also studied. Although propellants are usually not formulated to enhance bonding, understanding of the ingredient-bonding relationship is useful in aiding the selection of substrate chemical composition. L.S.

N65-31832# Atlantic Research Corp., Alexandria, Va.
RESEARCH ON THE DEFLAGRATION OF HIGH-ENERGY SOLID OXIDIZERS Quarterly Technical Summary Report No. 10, Sep. 1–Nov. 30, 1964
J. B. Levy and R. Friedman 19 Jan. 1965 19 p refs
(Contract AF 49(638)-1169)
(AD-463871)

Further measurements of the rate of deflagration of pressed strands of hydrazine diperchlorate at elevated pressures have been made. The data are erratic. The effect of copper chromite catalyst on the deflagration of hydrazine diperchlorate at atmospheric pressure has been examined at a higher catalyst content. Flame temperatures have been calculated for one, ten and one hundred atmospheres pressure and are fairly constant at 1600° K. Attempts at measurement of the flame temperature by means of fine Pt-Pt, 10% Rh thermocouples have been unsuccessful—apparently because of catalysis by the metals of condensed phase reactions. Exploratory experiments have been performed with ammonium perchlorate, hydrazine perchlorate and hydrazine diperchlorate on the deflagration of spheres of these oxidizers at atmospheric pressure in fuel gas streams. Author

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N65-31550 Bristol Siddeley Engines, Ltd. (England)
ROCKET ENGINES FOR SATELLITE LAUNCHERS
David Andrews [1965] 17 p refs Presented at the 5th European Spaceflight Symp., Munich, 19–22 Jul. 1965 Submitted for Publication

Three rocket engines are described in this paper. Two of these are being developed for possible future use in a satellite launcher, while the third is the engine on whose design the designs of these two engines are based. All these engines burn kerosine with H.T.P. The paper demonstrates the relevance of this general-purpose propellant technology to the launching of satellites. The basic rocket engine is the Gamma Mk. 304. This has four combustion chambers, fed with propellants by a single turbo-pump unit, and gives 25,000 lb thrust at sea level where the specific impulse is 217.4 lb s/lb. It is mounted in a 54 inch diameter motor bay and has numerous refinements to ensure the precision of the vehicle. The larger of the two new rocket engines, the BS 606, is virtually two Gamma Mk. 304 engines coupled together and re-engineered to suit a motor bay of 78.8 inches diameter. The BS 625 is a two-chambered rocket engine designed specifically for propulsion of a second or third stage of a satellite launcher. The provision made to secure high performance for a possible vehicle by ensuring the reliability and consistency of its propulsion system is specially featured in this account of the design and development of the two engines. Author

N65-31586# Auburn Research Foundation, Inc., Ala.
AN ANALYSIS OF THE STRESS CONDITIONS THAT COULD DEVELOP IN A SOLID FUEL ROCKET MOTOR Final Report
W. F. Swinson, W. F. Ranson, P. L. Anderson, and E. O. Jones, Jr. 29 Jun. 1965 74 p
(Contract DA-01-009-ORD-1023)
(AD-468280)

Thermal stresses were investigated in models which simulate the forward end of a solid propellant rocket motor. The first approximation, made to partially simulate the configuration of the forward end of the propellant grain, consisted of a hollow cylinder bonded at one end to a flat plate. This assembly was subjected to a uniform temperature change and theoretical and experimental stresses were determined. Material properties were determined experimentally prior to the investigation of the stresses in the model. Exploratory studies of various bonding methods and model casting techniques were made. Both two and three dimensional photoelastic stress analyses were conducted. A model more nearly simulating the forward end of the solid propellant grain was cast and a three

dimensional photoelastic stress analysis was made. A theoretical analysis using a high speed digital computer was also made. A preliminary investigation concerned with the use of strain gages embedded in the model, simulating the propellant grain, was conducted. R.N.A.

N65-31587# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
SYSTEM EFFECTS ON PROPELLANT STORABILITY AND VEHICLE PERFORMANCE First Quarterly Report, 3 May–23 Jul. 1965
[1965] 145 p refs
(Contract AF 04(611)-10750)
(SM-47918; AD-467569)

Continued research conducted under a program designed to study the influence of pertinent system design features and parameters on propellant storability and vehicle performance for a hypothetical LF_2/LH_2 manuevering space propulsion system, is reported. Progress is reported in the following areas: feed systems, feed system line losses, venting, vehicle thermal control, tank penetration and support system, pressurization system, and test apparatus. S.C.W.

N65-31804# Camin Labs., Inc., Brooklyn, N. Y.
ELECTROFORMING—A NEW TECHNIQUE FOR FABRICATION OF ROCKET MOTORS Final Report
S. Fialkoff 30 Oct. 1964 100 p refs
(Contract NOw-62-0870-c)
(Rept.-9; AD-464920)

Earlier reports under the subject contract detailed the various electroforming and associated fabrication of a 1000-lb. thrust regeneratively cooled liquid propellant rocket motor. This report details the efforts associated with the design and fabrication of a 500-lb. electroformed booster motor which was the main concern in the later phase of the program. All later fundamental process improvements are recorded, and the results of several successful test firings conducted at the Naval Weapons Laboratory, Dahlgren, Virginia are reported. Author

N65-31894# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONTROL OF GAS-TURBINE INSTALLATIONS
H. Ludwig 20 May 1965 26 p refs Transl. into ENGLISH from Messen, Steuern, Regeln. (Germany), v. 6, no. 12, 1963 p 517–524
(FTD-TT-65-136/1+2; AD-466509)

Problems appearing in control processes for gas-turbine installations are discussed. Single-cycle gas-turbine installations used for driving electrical generators, for powering locomotives, and for air compressors in metallurgical plants are considered; and diagrams showing the regulation of the installations are given. Also discussed are two-cycle installations (with free power turbine) used in ships, as air compressors, and in parallel connection-circuits. L.S.

N65-31896# Picatinny Arsenal, Dover, N. J. Feltman Research Labs.
INTERIOR BALLISTIC ANALYSIS OF VARIOUS GUN AND LAUNCHER SYSTEMS
A. G. Edwards Jun. 1965 93 p refs
(PA-TR-3193; AD-467617)

The technique of designing various types of gun and launcher systems by the simulation of test firings on an analog computer is described. Equations are derived to represent the performance of a generalized gunlauncher system which may have a combination of m propellants of i granulations in various locations within the system. These equations are used to develop various sets of reduced equations which describe various specific systems such as ordinary closed breech guns, high-low guns, recoilless rocket launchers, etc. The equations used to describe each system, the incorporation of experimental or test data to improve the representation, the accuracy of the "simulated" results as compared with actual firing results, and the use of these tools in designing, modifying, developing, and evaluating weapon systems are discussed in this report. Also presented is a description of the versatility of this technique with respect to modification to include almost any proposed innovation in a weapon system. Author

N65-31898# California Univ., Berkeley. Inst. of Engineering Research.
CALCULATION OF ENGINE PERFORMANCE USING AMMONIA FUEL I: OTTO CYCLE
H. K. Newhall 28 Apr. 1965 45 p refs *Its* Tech. Rept.-2
(Contract DA-04-200-AMC-791(X))
(HPS-65-1; AD-466101)

A study was conducted to predict the performance of ammonia as a spark ignition engine fuel. An Otto cycle was used as a theoretical model with the combustion and expansion processes incorporating chemical equilibrium products corresponding to the fuel–air mixture considered. The effects of heat transfer and finite combustion time are neglected. Iso-octane was used as a reference fuel. Vapor phase ammonia fuel yields 12 to 14% less power than iso-octane. Liquid ammonia shows an increase in power output of 12 to 15% over iso-octane. In either liquid or vapor phase ammonia, thermal efficiency is 5% greater and specific fuel consumption ranges from 2.5 to 3.5 times that of iso-octane. Exhaust concentration of NO is much less for ammonia than for iso-octane at the same air-fuel equivalence ratio. R.N.A.

N65-31925# Eurospace, Paris (France).
THE AIMS OF THE EUROPEAN SPACE PROGRAM WITH SPECIAL REFERENCE TO PROPULSION SYSTEMS AND ENERGY-SOURCES
O. Lutz Sep. 1964 32 p
(Rept.-7003)

A review of propulsion systems and energy sources, and their relation to present and future space problems is presented for clarifying the position, role, and aims of the European space program. Air-breathing, hybrid, solid rocket, and liquid rocket engines are discussed. Also discussed are electric, electrostatic, electromagnetic, and nuclear propulsion systems; and combinations of engine systems. Combustion chamber temperature and pressure problems, thrust, fuel consumption, cooling procedures, expansion ratio, air heating, design layout, exhaust velocity, payload, feed systems, and other factors are considered. The role of auxiliary power sources such as chemical batteries and solar cells is surveyed. Recommendations for cooperation in research and development activities between European countries are made to meet the future space technology. L.S.

N65-31939# Aerojet-General Corp., Sacramento, Calif.
GEMINI ENGINE INCENTIVE DEMONSTRATION CATALOG
21 Oct. 1964 49 p
(Contract AF 04(695)-393)
(Rept.-393-C-CT2-1; AD-462892)

Criteria for determining engine countdown and flight performance incentive success or failure for the GLV-2 launch vehicle are defined. Included are the ground rules for countdown and flight demonstration evaluation; the significant steps and scheduled holds in the countdown pertaining to the engine; check lists for verifying successful countdown and flight performances; and the engine instrumentation list. Check lists for engine performance criteria, and a flow diagram of engine flight

performance evaluation procedures are also included. Requirements for engine prelaunch operation, and for fuel and oxidizer tank autogenous gas are graphically depicted, and instrumentation schematics are presented. C.T.C.

N65-32086*# Chrysler Corp., Huntsville, Ala. Space Div.
SATURN S-IB STAGE Final Static Test Report
J. V. Wible and R. D. Cox 4 Jun. 1965 150 p refs
(Contract NAS8-4016)
(NASA-CR-64449) CFSTI: HC $4.00/MF $1.00 CSCL 21H

The acceptance test firing of the Saturn flight stage S-IB-1 is described. The primary objective of the static firing tests was to demonstrate the correct functional performance and operation of the airborne systems under simulated launch conditions. Presented are results of two static firings, a short duration firing, and a long duration firing. The short duration firing constituted a confidence test to verify airborne/ground control system compatibility, to check out instrumentation, and to obtain engine thrust level data. The long duration firing constituted an acceptance test and confirmed the correct operation of all airborne systems. Overall stage functional performance was found to be acceptable during both tests. Included are data on: engine systems, engine hydraulic systems, propellant and pneumatic systems, engine compartment environment, vibration and special instrumentation, electrical control systems, and telemetry systems. S.C.W.

N65-32107# Thiokol Chemical Corp., Denville, N. J. Reaction Motors Div.
THE GENERATION OF CHARGED COLLOIDS FOR ELECTRIC PROPULSION VIA HETEROGENEOUS CONDENSATION IN VACUUM OF METAL VAPORS ON A SURFACE Final Report, 20 Jun. 1960–19 Dec. 1963
Bernard Hornstein Mar. 1964 42 p refs
(Contract AF 49(638)-924)
(RMD-2049-F; AFOSR-65-0925; AD-617120)

Efforts to define a process for generating charged colloids useful for electric propulsion were not successful. Emphasis was placed upon the formation of particles by condensing metal vapors upon a solid surface in a vacuum. This was followed by a step where an applied electrostatic field would inductively charge the particles and apply a force to overcome the adhesion between particle and substrate. The limitation proved to be particle removal; quantitative and reliable particle removal was not accomplished at imposed V/d values of 3.5×10^7 Vm^{-1}. Although most of the removal experiments were upon the lead-carbon system, it can be expected that other systems with interfacial adhesion one, two, or three orders lower than Pb/C would be exceptional, and that electrostatic removal would be difficult. R.W.H.

N65-32258*# Aerojet-General Corp., Sacramento, Calif.
260-IN.-DIA MOTOR FEASIBILITY DEMONSTRATION PROGRAM. VOLUME I: 260-SL MOTOR AFT-END IGNITION SYSTEM DEVELOPMENT Final Phase Report
20 Aug. 1962 275 p refs
(NASA-CR-54454; FPR-1) CFSTI: HC $6.00/MF $1.50 CSCL 21H

The 260-SL motor ignition system development program was conducted to demonstrate the capability of an aft-end solid-propellant igniter to ignite the 260-SL motors. A mathematical model was derived to define the gas dynamics of aft-end ignition and to provide the parameters required for aft-end ignition system design. The test program demonstrated the ignition capability of the ignition system and provided sufficient data to verify the mathematical model and the criteria used for the design of the ignition system. The 44-in.-dia subscale motor ignition system development program further verified the 260-SL motor ignition system design criteria and provided preliminary data on the igniter ejection sequence. The aft-end ignition performance in three 44-SS motors showed predictable and reproducible performance. All objectives of the development program were achieved and the ignition capability of the 250-SL motor ignition system was fully demonstrated. Author

N65-32281# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CENTRIPETAL GAS TURBINE
R. B. Abramovich, L. S. Arinvushkin, I. F. Vaynbaum, V. I. Dumov, Yu. N. Mikhaylov et al 14 Jul. 1965 6 p Transl. into ENGLISH from Russian Patent no. 166555 (Appl. no. 843067/24-6, 24 Jun. 1963) 2 p
(FTD-TT-65-198/1+2+4; AD-618647)

Described is a centripetal gas turbine with borings in the ring designed conical on the input and cylindrical on the output, so that the forward outflow edge of each preceding nozzle intersects the rear outflow edge of the succeeding nozzle. The primary advantages of the proposed design are that the engineering technology of the nozzle apparatus is simplified, and input and output losses are reduced. S.C.W.

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N65-31295 Joint Publications Research Service, Washington, D. C.
MEASUREMENT OF THE POLARIZATION OF SOLAR RADIO EMISSION DUE TO THE TOTAL MAGNETIC FIELD OF THE SUN
I. F. Belov *In its* Izv. VUZov: Radiofiz., Vol. VIII, No. 2, 1965 10 Aug. 1965 p 233–235 refs (See N65-31275 20-23) CFSTI: $6.00

Measurements of polarization caused by the total magnetic field of the sun were made in the three centimeter range by scanning the directivity pattern of an antenna. Total magnetic field can be estimated by determining its distribution, and this can be easily accomplished if the distribution is assumed to be homogeneous. However, if it is assumed that distribution is of a dipole nature, which is probably closer to actuality, then the evaluation made is greatly underestimated. In a further series of observations, large values for the polarization components were noted (~20 to 30° K) which were though to be due to the reception of radioemission associated with sunspots. When observed effect of polarization was ~ 1° K, no noticeable sunspots were seen. It is pointed out that this latter result does not exclude local sun formations, such as floccula, with weak magnetic fields. M.W.R.

N65-31363 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE EFFECTS OF HIGH-ALTITUDE EXPLOSIONS
Wilmot N. Hess 14 Apr. 1964 *In* Space Technol. Labs., Inc. Selections from the TRW Space Technol. Labs. Lecture Ser., Vol. 2, 1965 p 22–34 refs (See N65-31360 20-34)

Detailed calculations are presented for the Starfish explosion to determine the effects, phenomena, and formation of the artificial belt which develops from a point source nuclear explosion. Results of satellite radiation measurements are reported, and particle motion, electron distribution, neutron decay, trapped-particle life-times, electron flux, and radiation damage are discussed. M.R.W.

N65-31366 California Univ., Berkeley.
ENERGETIC SOLAR PARTICLES
Kinsey A. Anderson 19 May 1964 *In* Space Technol. Labs., Inc. Selections from the TRW Space Technol. Labs. Lecture Ser., Vol. 2 1965 p 51–60 refs (See N65-31360 20-34)

Properties of solar particle emission and consequences of these radiations are reported. A summary is presented on measurement techniques and observational data of energetic particle production by the sun, and details of particle acceleration in the solar atmosphere are reviewed. A solar X-ray burst is discussed to illustrate the processes occurring in the sun's atmosphere and the magnitude of the physical quantities entering into them. A comparison of the X-ray observations with an extensive set of radio-noise records was carried out to obtained information concerning the height at which fast-flare electrons reside. M.R.W.

N65-31552*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COMPOSITION OF SOLAR COSMIC RAYS
S. Biswas (Tata Inst. of Fundamental Res., Bombay, India) and C. E. Fichtel May 1965 63 p refs Submitted for Publication
(NASA-TM-X-55230; X-611-65-219) CFSTI: HC $3.00/MF $0.75 CSCL 20H

A review of solar particle composition is presented. The charge spectrum of the solar nuclei and the energy spectra of different nuclear charge groups are discussed. Data are given on the isotopic composition of the hydrogen and helium nuclei. Experiments to detect solar electrons and neutrons are summarized. Discussions are also included on the propagation of solar particles in interplanetary space, the acceleration of high energy solar particles, the relationship of solar cosmic ray composition to that of the sun, and the difference between the composition of the solar and galactic cosmic rays. R.N.A.

N65-31642# Uppsala Univ. (Sweden). Cosmic Ray Group.
GEOPHYSICAL ASPECTS OF COSMIC RAYS Final Report
A. E. Sandström 15 Apr. 1965 21 p refs
(Grant AF-EOAR-64-64)
(AFCRL-65-418; AD-618562)

A short survey is given of the research work presented in Scientific Reports No:s 1 and 2 together with some additional remarks. A separate section is devoted to the data recorded during the first 18 months performance of the plastic scintillator meson monitors at Uppsala. A short account is added concerning some studies related to and of importance for those covered by Scientific Reports No:s 1 and 2. Author

N65-31851# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
TRAJECTORY-COMPUTED VERTICAL THRESHOLD RIGIDITIES FOR 85 NEUTRON MONITOR STATIONS
M. Kodama Nov. 1964 38 p refs
(CRGP-1208; AECL-2134) Available from Atomic Energy of Canada, Chalk River: $1.00

As an extension of the trajectory calculations for asymptotic directions of cosmic ray particles, the vertical threshold rigidities for 85 cosmic ray stations have been determined with an accuracy of 0.1 GV. It is shown that the differences of the new threshold rigidities are not negligibly small for particular stations, and also they are fairly sensitive to the difference of the geomagnetic field simulation adopted for the computation. The new values are evaluated by applying them to typical cosmic ray disturbance events throughout the last solar cycle. Author

N65-31948# Franklin Inst., Swarthmore, Pa. Bartol Research Foundation.
STUDY OF COSMIC RADIATION FLUX AT THE EARTH'S POLE Final Report, Apr. 15, 1961–Apr. 14, 1965
M. A. Pomerantz 14 Jun. 1965 80 p refs
(Contract AF 19(604)-8061)
(AFCRL-65-445; AD-467098)

A high counting rate meson telescope was constructed, and put into operation at AFCRL Geopole Station, Thule. The conventional neutron monitor was continued in operation for a period following the installation of the new high counting rate neutron monitor. Computer programs for data processing have been developed. Analyses of cosmic ray intensity variations have included the newly-discovered 20-day recurrence tendency, solar particle events, Forbush decreases, the solar cycle modulation, and the solar diurnal variation. A program of neutron multiplicity spectrum measurements has been undertaken. Apparatus has been developed and tested, and is now engaged in a systematic study of the variation of multiplicity with atmospheric pressure and threshold rigidity. Preliminary results have been obtained. An analysis of measurements of the latitude variations of the atmospheric attenuation has revealed that the results are in accord with predictions based upon accepted models of the propagation process. Author

N65-31975# National Bureau of Standards, Boulder, Colo. Central Radio Propagation Lab.
SOLAR-GEOPHYSICAL DATA, PART B
Jun. 1965
(CRPL-F-250, Pt. B)

Tabulated solar and geophysical data are presented on daily solar indices, solar centers of activity, solar flares, solar radio waves, cosmic ray indices, geomagnetic activity indices, radio propagation quality indices, and alert periods and special world intervals. R.N.A.

N65-32056# United Nuclear Corp., White Plains, N.Y. Development Div.
GAMMA SCANNING OF SATAR SATELLITE WL-412 Final Report, 1 Dec. 1964–15 Mar. 1965
G. Foster Kirtland AFB, N. Mex., AF Weapons Lab., May 1965 43 p refs
(Contract AF 29(601)-6685)
(UNC-5108; AFWL-TR-65-35; AD-615925)

The areal density distribution about detector positions for Tissue Equivalent Ion Chambers (TEICs) and Linear Energy Transfer (LETs) detectors was determined by a gamma probe technique. The survey was conducted on the SATAR Satellite WL-412, a space vehicle which will be subjected to irradiation by energetic protons. The results of computer runs have been used to calculate a proton dose of 2.3×10^{-7} rad/unit flux. Detailed electron density distributions and corresponding solid angle tables in the form of computer printouts are available as references. Author

N65-32116*# California Univ., La Jolla.
RADIOACTIVITY INDUCED IN NaI BY TRAPPED PROTONS
Laurence E. Peterson [1964] 11 p refs Partly Prepared at Minnesota Univ.
(Contracts NASw-56; NAS5-3312; Grant NsG-318)
(NASA-CR-59253) CFSTI: HC $1.00/MF $0.50 CSCL 20H

Radioactivity induced in an array of NaI scintillation counters in the detection system of the Orbiting Solar Observatory (OSO-1) is reported for the periods when the satellite passed through the lower edge of the inner Van Allen zone over the South Atlantic region. Protons in the inner Van Allen zone produce neutrons in the satellite materials which are captured by the I^{127} to form I^{128}. Illustrations are included of the

counting rate versus geographic latitude at 600 kilometers; the trajectories of a series of passes; and rates versus time for two of the passes. The γ-ray rates in the trapped radiation were found to be very high. Results are also shown for deleting cosmic-ray background and fitting the excess rates to radioactive decay law. M.W.R.

N65-32121*# Catholic Univ. of America, Washington, D. C. Dept. of Space Science and Applied Physics.
AN INVISCID MODEL OF THE SOLAR WIND
Y. C. Whang and C. C. Chang Sep. 1964 22 p refs (Grant NsG-417)
(NASA-CR-59334) CFSTI: HC $1.00/MF $0.50 CSCL 20H

In this paper we consider an inviscid, thermal conductive, spherically symmetric model of the solar wind. The equations of mass, momentum and energy conservation are integrated simultaneously to give a unique solution for this solar wind model. The solution obtained smoothly passes through the critical radius and satisfies the condition $T = o$, as $r \to \infty$. The quantitative physical implication of the solution is discussed. Author

N65-32157*# California Inst. of Tech., Pasadena.
RATES OF NUCLEAR REACTIONS IN SOLID-LIKE STARS
Richard A. Wolf [1964] 35 p refs Submitted for Publication (Grant NGR-05-002-028; Contract Nonr-220(47))
(NASA-CR-59444) CFSTI: HC $2.00/MF $0.50 CSCL 03B

In the interior of a star the Coulomb energies between neighboring nuclei are large compared to the kinetic energies of the nuclei. Each nucleus is constrained to vibrate about an equilibrium position and the motion of the nuclei in the interior is similar to the motion of the atoms in a solid or liquid. We propose a solid-state method for calculating the rate at which a nuclear reaction proceeds between two identical nuclei oscillating about adjacent lattice sites. An effective potential U(r) derived by analyzing small lattice vibrations is used to represent the influence of the Coulomb fields of the lattice on the motion of the two reacting nuclei. The wave function describing the relative motion of the two reacting particles is obtained by solving the Schrodinger equation containing the effective potential U(r). From this wave function, we derive an expression for the reaction rate. Author

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N65-31263# Argentine National Commission on Space Research, Buenos Aires.
INTERAMERICAN SYMPOSIUM ON SPACE RESEARCH, PROCEEDINGS, VOLUME I [SIMPOSIO INTERAMERICANO DE INVESTIGACIONES ESPACIALES, TRABAJOS PRESENTADOS, VOLUMEN I] Special Publication No. 3
1965 87 p refs Symp. Held at Buenos Aires, Aug. 1964 (CNIE-PE-3)

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1. THE GLOBAL COMMERCIAL COMMUNICATIONS SATELLITE SYSTEM—AN UP-TO-DATE SUMMARY AND REVIEW E. J. Istvan 6 p (See N65-31264 20-07)

2. HASP-A FAMILY OF U. S. NAVY METEOROLOGICAL ROCKETS M. J. Parker 20 p (See N65-31265 20-31)

3. THE THERMAL SIMULATION OF SPACE R. W. Porter, M. W. Mitchell, and F. O. Drummond 29 p refs (See N65-31266 20-30)

4. NASA SPACE ELECTRONICS RESEARCH G. A. Vacca 27 p (See N65-31267 20-10)

N65-31266 General Electric Co., Philadelphia, Pa. Missile and Space Div.
THE THERMAL SIMULATION OF SPACE
R. W. Porter, P. W. Mitchell, and F. O. Drummond *In* Arg. Natl. Comm. on Space Rws. Interam. Symp. on Space Res., Proc., Vol. 1 1965 29 p refs (See N65-31263 20-30)

A study of thermal simulation of space environments is presented and includes discussions on the need for space environment simulation test facilities, the thermal environment in space, space simulation techniques and problem areas, major space simulator systems, and space simulation tests. R.N.A.

N65-31276 Joint Publications Research Service, Washington, D. C.
OBSERVATIONS OF RADIO ECLIPSES OF THE MOON AT MILLIMETER WAVELENGTHS
S. A. Kamenskaya, A. G. Kislyakov, V. D. Krotikov, A. I. Naumov, V. N. Nikonov et al *In its* Izv. VUZov: Radiofiz., Vol. VIII, No. 2, 1965 10 Aug. 1965 p 1–15 refs (See N65-31275 20-23) CFSTI: $6.00

Variation of effective temperature of the moon was measured at millimeter wavelengths during two eclipses by a method developed to observe radio emission from the moon. Observations wer made in Armenia at an elevation of 3250 meters; and the eclipse was observed at 1.2, 2.1, 4.0, 7.5, and 16 mm by radio telescopes with parabolic mirrors on azimuth-vertical mounts. Maximum relative drops in effective temperature are given for both eclipses. Both agreement between observed data and calculated results of the course of the eclipse for a uniform model of the moon is obtained if $\gamma/b = (6^{+1.5}_{-1.0}) \cdot 10^4 (\gamma = k\rho c)^{1/2}$; k = thermal conductivity, ρ = density, c = heat capacity, and b = specific loss angle of lunar material. Within limits of measurement accuracy, the obtained value γ/b for the upper layer of lunar rock coincides with measurements of phase dependence of lunar radio emission and characterizes properties of lower layers. M.W.R.

N65-31277 Joint Publications Research Service, Washington, D. C.
FREQUENCY AND TIME DEPENDENCE OF FLUX DENSITY RATIO OF THE DISCRETE SOURCES CASSIOPEIA-A AND CYGNUS-A AT DECAMETER WAVELENGTHS
S. Ya. Braude *In its* Izv. VUZov: Radiofiz., Vol. VIII, No. 2, 1965 10 Aug. 1965 p 16–22 refs (See N65-31275 20-23) CFSTI: $6.00

The author considers possible causes of the "break" in the frequency spectrum of the sources Cassiopeia-A and Cygnus-A and proposes a method of elucidating the mechanism of this break from the experimental data. It is shown that at decameter wavelengths the observed decrease in the flux of Cassiopeia-A with time exceeds the corresponding theoretical value. Author

N65-31367 National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
THE ORIGIN OF PLANETARY ATMOSPHERES
A. G. W. Cameron 3 Mar. 1964 *In* Space Technol. Labs., Inc. Selections from the TRW Space Technol. Labs. Lecture Ser., Vol. 2 1965 p 61–70 ref (See N65-31360 20-34)

Various processes are considered which might lead to the formation of an atmosphere for most of the planets. Mechanisms for input of gases into an atmosphere, and for loss of

gases from an atmosphere are discussed. The structure of the atmospheres of Jupiter, Mars, and Venus is illustrated. Microwave brightness measurements of Venus are interpreted. The atmosphere of the earth is discussed in terms of whether the amount of the rare gases present are derived by outgassing, by capture from the primitive solar nebula, or by some other process. This problem is investigated by examining the isotopic composition of xenon. The composition of xenon extracted from the Murray carbonaceous chondrite is used as a standard to measure the deviations of xenon in other sources. M.R.W.

N65-31575*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

ASCENT FROM THE LUNAR SURFACE

Rowland E. Burns and Larry G. Singleton Washington, NASA, Aug. 1965 170 p refs Corrected copy
(NASA-TN-D-1644) CFSTI: HC $5.00/MF $1.00 CSCL 22C

The problem of three-dimensional optimal ascent from the lunar surface is discussed in the report using the techniques of variational calculus. The Moon is assumed to be spherical and rotating, but perturbational effects from all other bodies are neglected. Final orbital inclination is calculated under the assumption that the angular displacement of the moon is negligible during ascent. Only single stage vehicles are considered and are subdivided into propellant and final mass in orbit, i.e., there is no consideration of payload dependencies upon structural mass, etc. Furthermore, both the thrust and mass flow rate are assumed constant throughout the powered flight for a given vehicle. Author

N65-31724# RAND Corp., Santa Monica, Calif.

INHOMOGENEOUS COSMOLOGICAL MODELS I. CONFORMAL HOMOGENEITY

Dominic G. Edelen Jul. 1965 27 p refs
(P-3171; AD-617879)

Inhomogeneous cosmological models are obtained by a conformal transformation of the line element of the previous homogeneous models. The models exhibit a number of features not phenomenologically different from recent observational findings. Mass distributions can be found that reflect actual galactic clustering. For such clusters, the cluster centers have the same predicted distance-velocity relations as found in the homogeneous models and the same red shift relations to within terms of second order. Dispersion velocities relative to the cluster centers are exhibited. If the cluster centers are assumed to be equally spaced in space, their observed pattern will exhibit a uniform foreshortening for the more distant ones while the nearer objects will show nonuniform foreshortening. Deviations from a regular pattern thus show up in the near field and become asymptotically regular at large distances. Author

N65-31906# Kyoto Univ. (Japan).

MORPHOLOGICAL FEATURES OF THE LIBRATORY REGION OF THE MOON

S. Miyamoto 1964 17 p refs Presented at the Conf. on Geol. Probl. in Lunar Res., New York Acad. of Sci., 16–19 May 1964
Its Contrib. No. 135

Photographic observation was carried out at the Kwasan observatory for the geological study of libratory regions of the moon. Morphological characters of maria in the libratory region are quite different from normal maria. Mare Australe, for example, may be considered as an assembly of craters with dark floor. Normal maria may develop from them by mutual fusion of constituent dark craters at the earliest epoch of crustal formation. Continental areas in the libratory region are covered with fine and coarse network of tectonic, which, however, does not always follow regular patterns of global origin. Maria and craters were arranged in morphological sequences and in morphological sequences and an interpretation was given in terms of the thickness of silicic crust from the viewpoint of endogenetic origin of lunar crustal features. Author

N65-31964# Manchester Univ., Macclesfield (England). Dept. of Astronomy.

TURBULENCE AND RESOLUTION IN ASTRONOMICAL PHOTOGRAPHY

Roger F. Edgar Jan. 1964 76 p refs
(Contract AF 61(052)-496)
(TN-4; AD-614680)

A method is outlined of studying, individually and collectively, all the effects which influence the resolution of an astronomical telescope used to photograph celestial objects. A method of optimising the resolution is considered. Author

N65-32012# Joint Publications Research Service, Washington, D. C.

DIRECT DETERMINATION OF THE ASTRONOMICAL-GEODETICAL DEFLECTION OF THE VERTICAL

N. A. Belyayev 26 Aug. 1965 11 p Transl. into ENGLISH from Geodez. i Kartograf. (Moscow), no. 6, Jun. 1965 p 3–9
(JPRS-31735; TT-65-3230) CFSTI: $1.00

The derivation of the components of the astronomical-geodetic deflection of the vertical and of the geodetic azimuth by the direct method with an error of less than ±0.15 seconds is discussed. Photoelectric observations in two verticals of 50 to 60 pairs of stars in the interval of zenith distances 30° to 60° are required. This amount of work corresponds to that done in making astronomical observations to determine the latitude and longitude of a point of the first class by pairs of stars at corresponding elevations. Equations are given for the method and the error in determining the components of astronomical-geodetic deflection when the exact astronomical coordinates are unknown is considered. E.E.B.

N65-32025*# New Mexico State Univ., University Park. Observatory.

A RAPIDLY MOVING SPOT ON JUPITER'S NORTH TEMPERATE BELT

Elmer J. Reese and Bradford A. Smith Jul. 1965 20 p refs
(Grant NsG-142-61)
(NASA-CR-64568; TN-701-66-9) CFSTI: HC $1.00/MF $0.50 CSCL 03A

A very rapid drift in the longitude of a small dark spot on the south edge of Jupiter's North Temperate Belt (NTBs) was determined from 51 blue and ultraviolet photos. The spot made seven complete circuits of the planet during 268 days of observation between July 1964 and April 1965. Mean daily rotation period of the spot was calculated as $9^h49^m18^s.5$. The center of the spot remained stationary near zenographic latitude +24°, within the probable error of the measures. This spot was almost completely invisible to the visual observer; it represents the fifth observed outbreak of activity in the North Temperature Current. Rapidly rotating spots in this latitude seem to appear in 12-year intervals. G.G.

N65-32026*# New Mexico State Univ., University Park. Observatory.

RECENT MEASURES OF THE LATITUDE AND LONGITUDE OF JUPITER'S RED SPOT

Elmer J. Reese and H. Gordon Solberg, Jr. Jun. 1965 16 p refs
(Grant NsG-142-61)
(NASA-CR-64569; TN-557-65-7) CFSTI: HC $1.00/MF $0.50 CSCL 03A

The latitude and longitude of Jupiter's Red Spot were measured from photographic plates obtained between June 1962 and May 1965 at the New Mexico State University

Observatory. The longitudes measured from photographs have been found to be an order of magnitude more accurate than the longitudes obtained from visual estimates of central meridian transit times. The Red Spot was observed to increase irregularly in System II longitude from 10° in June 1962 to 24° in May 1965. The significantly improved accuracy of photographic observations made possible the detection of rapid, short term changes in longitude. The Red Spot slowly oscillated in latitude, remaining within 1°.4 of its mean latitude of 22°.4 for the reported interval. Author

N65-32029*# Space Technology Labs., Inc., Redondo Beach, Calif.
MONTE CARLO SIMULATION OF MIDCOURSE GUIDANCE (TAPP MOD II)
W. H. Pace, Jr. [1962] 33 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950045)
(NASA-CR-64574; STL-8976-6012-RU-000) CFSTI: HC $2.00/MF $0.50 CSCL 22C

A linear perturbation model is used in a Monte Carlo simulation of the midcourse guidance problem. The generalized midcourse guidance scheme is briefly described, and symols used in the equations in the simulation are listed and defined. A logical sequence for performing the calculations involved in the simulation, and a sequence for performing calculations in the processor is shown. Equations for the processor are given, and the function of the processor is described. Also given are the required inputs, and the modes of operation for the simulation. L.S.

N65-32030*# Philco Corp., Palo Alto, Calif. Western Development Labs.
COMET AND CLOSE-APPROACH ASTEROID MISSION STUDY Second Technical Progress Report, 2 Sep.–2 Nov. 1964
13 Nov. 1964 99 p Prepared for JPL
(Contracts NAS7-100; JPL-950870)
(NASA-CR-64575; WDL-TR-2349) CFSTI: HC $3.00/MF $0.75 CSCL 22A

Development of conceptual spacecraft designs is discussed for missions to selected comets and close-approach asteroids during the mission period 1967–1975. The structure and composition of comets for use as a final model were specified, and data were collected on orbital characteristics, physical properties, and composition of selected close-approach asteroids in the area of science. Among the findings resulting from trajectory and guidance studies are that a preacquisition study is needed to refine the orbital characteristics of the comet well in advance of any planned launch, and that the encounter distance from the nucleus of the comet may be controlled between 5000 and 10 000 km. System requirements include a tabulation of mission characteristics and constraints. Feasibility studies are included for the attitude control and propulsion subsystems. Topics considered under telecommunication are the system, system requirements, and antenna coverage. Photovoltaic and isotopic power subsystems are also considered. Methods and subsystems for thermal control, and the development of two configurations are discussed. C.T.C.

N65-32031*# Harvard Coll. Observatory, Cambridge, Mass.
ISOTHERMS IN THE REGION OF PROCLUS AT A PHASE ANGLE OF 9.8 DEGREES Scientific Report No. 5
Andrew T. Young and Harold Boeschenstein, Jr. 15 Sep. 1964 12 p refs
(Grant NsG-64-60)
(NASA-CR-64576) CFSTI: HC $1.00/MF $0.50 CSCL 03A

An isothermal map of the Proclus area of the Moon and a description of the method used for making the map are presented. Correlation between the isotherms and the visual features is also given. Author

N65-32082*# Geophysics Corp. of America, Bedford, Mass.
PLANETARY METEOROLOGY Quarterly Progress Report No. 1, 21 Mar.–30 Jun. 1965
20 Jul. 1965 61 p refs
(Contract NASw-1227)
(NASA-CR-64432) CFSTI: HC $3.00/MF $0.75 CSCL 03A

Studies on the meteorology of Mars and Venus are reported. Included are data on the seasonal climatology of Mars, diurnal variation of the surface temperature on Mars, interhemispheric transport of water vapor and the Martian ice caps, comparative studies of zonal wind velocities on Mars and Earth, atmospheric circulation in the Venusian atmosphere, and the composition of the Venusian clouds. S.C.W.

N65-32093*# American Mathematical Society, New York.
THE EARTH-MOON IN THE LIGHT OF RECENT DISCOVERIES IN SPACE SCIENCE
J. A. O'Keefe [1964] 48 p
(Grant NsG-358)
(NASA-CR-59221) CFSTI: HC $2.00/MF $0.50 CSCL 03A

Lectures dealing with the physical setting of geodesy and the physical significance of the flattening of the earth are presented in a paper dealing with the earth-moon system in terms of recent discoveries in space science. Geoid heights in meters and free air geoids for the eastern and western hemispheres are illustrated. A series of equations is developed for determining hydrostatic flattening of the earth; and the results indicate that hydrostatic flattening is less than actual flattening. This difference could be attributed to the melting of the polar ice caps and some lages in the restoration of isostasy, or considered a consequence of the fact that the polar caps are colder than the equator. The most plausible explanation offered, however, is the retardation in the earth's rotation over the past million years. It is pointed out that, in any event, the flattening is a direct function of polar inertia; and presently observed values of the actual flattening are better than those needed to make a satisfactory calculation of the hydrostatic flattening. M.W.R.

N65-32112*# Colorado Univ., Boulder. Lab. for Atmospheric and Space Physics.
FINE STRUCTURE OF THE ABSORPTION CROSS-SECTION OF GASES IN THE ULTRAVIOLET AND AN ANALYSIS OF THE RAY SYSTEM OF THE LUNAR CRATER TYCHO Scientific Report No. 3, Sep. 1963–Apr. 1964
Martin Sedlacek May 1964 32 p refs
(Contract NASr-86)
(NASA-CR-56924) CFSTI: HC $2.00/MF $0.50 CSCL 03B

The design of an instrument to measure the energy spectrum of electrons, and a theoretical investigation of the Tycho ray system on the moon are considered. The experimental apparatus consists of three main parts: (1) the vacuum-monochromator and the light source; (2) ionization chamber and electron spectrometer; and (3) detector and counter. The fine structure of the absorption process was revealed. The very long rays of the Tycho system are considered. There is evidence, that Tycho's position with respect to the axis of rotation was changed after the deposition of the rays. The system shows left and right-handed curvature with a distince symmetry, indicating that Tycho once was near or even on the equator. It was shown that one can calculate the time which elapsed since the formation of the Tycho system. R.W.H.

N65-32114*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE INFRARED INTERFEROMETER SPECTROMETER EXPERIMENT (IRIS). VOLUME I: MARTIAN FLY-BY MISSION

R. A. Hanel and L. Chaney Jul. 1964 56 p refs

(NASA-TM-X-55070; X-650-64-204) CFSTI: HC $3.00/MF $0.50 CSCL 03A

The extraction of significant information on the atmosphere and surface of Mars from thermal emission of the planet is discussed. Also, the design of an infrared interferometer capable of measuring thermal emission spectrum of the planet is described; the requirements and constraints of the infrared interferometer experiment on a planetary fly-by spacecraft are documented. The information will be extracted from the thermal emission spectrum within the interval of 2000 cm^{-1} to 500 cm^{-1}. The experiment is aimed at a wide spectral range to permit clear identification of many predictable spectral features and to allow a search for unexpected phenomena. For a nominal fly-by distance of 5000 km, the resolved area will be a circle of 250-km diameter. E.E.B.

N65-32117*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE LUNAR RILLS

Winifred Sawtell Cameron [1964] 8 p refs Submitted for Publication

(NASA-TM-X-54816) CFSTI: HC $1.00/MF $0.50 CSCL 03B

Presented is a discussion on the origin and classification of lunar rills. Considered are valley-like rills, normal-, sinuous-, and crater-chain-rills. Also cited are data from Ranger-VII photographs of the lunar surface. S.C.W.

N65-32183*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

TWO-CENTER PROBLEM ORBITS AS INTERMEDIATE ORBITS FOR THE RESTRICTED THREE-BODY PROBLEM

R. G. Langebartel Washington, NASA, Sep. 1965 23 p refs

(NASA-TN-D-2939) CFSTI: HC $1.00/MF $0.50 CSCL 03C

The restricted three-body problem is treated by keeping for the intermediate orbit Hamiltonian all terms except those representing a generalization of the centrifugal and Coriolis forces. The intermediate orbit, therefore, takes into account the gravitational forces of both finite masses. An approximation is presented for representing a class of intermediate orbits similar to the orbits suggested for the Apollo project. The perturbation equations are given in outline. Author

N65-32199*# Stanford Univ., Calif. Radioscience Lab.

THE TWO-FREQUENCY, BISTATIC RADAR-OCCULTATION METHOD FOR THE STUDY OF PLANETARY IONOSPHERES Scientific Reports No. 1 and No. 7

G. Fjeldbo, V. R. Eshleman, O. K. Garriott, and F. L. Smith, III Apr. 1965 33 p refs

(Grants NsG-377; NGR-05-020-065)

(NASA-CR-64460; SEL-65-044) CFSTI: HC $2.00/MF $0.50 CSCL 03B

A method for the study of planetary ionospheres is presented which is based on the use of radio waves propagated between the earth and a spacecraft on an occulting trajectory beyond the planet. Phase path, group path, or amplitude measurements made during spacecraft immersion into, and emersion from, the occulted zone could be used to deduce vertical electron density profiles at the two limb positions probed by the waves. By using two or more harmonically related frequencies, the ionospheric measurements would be self-calibrating, thus avoiding the extreme measurement and computational precision that otherwise would be required. It is suggested that this simple technique would be particularly applicable for the initial exploration of planetary atmospheres. Author

N65-32251*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

SPACE ENVIRONMENT CRITERIA GUIDELINES FOR USE IN SPACE VEHICLE DEVELOPMENT (1965 REVISION)

Robert E. Smith, ed. 27 May 1965 91 p refs

(NASA-TM-X-53273) CFSTI: HC $3.00/MF $0.75 CSCL 22A

This document provides guidelines on interplanetary space, terrestrial space, near-Venus space, near-Mars space, lunar atmosphere and surface, and Mars atmosphere and surface environmental data applicable for Marshall Space Flight Center space vehicle development programs and studies related to future NASA programs. This report establishes design guideline values for the following environment parameters: meteoroids, secondary ejecta, radiation, gas properties, magnetic fields, solar radio noise, winds, wind shear, clouds, ionosphere, albedo, planetary surface conditions, planetary satellites, composition of the planetary atmospheres, temperature, and astrodynamic constants. Additional information may be located in the references cited. Author

N65-32273*# National Aeronautics and Space Administration, Washington, D. C.

SPACE RESEARCH IN ARGENTINA [LA INVESTIGACION ESPACIAL EN LA ARGENTINA]

Aug. 1965 25 p refs Transl. into ENGLISH of a report presented to COSPAR, Buenos Aires, 10–21 May 1965

(NASA-TT-F-9524) CFSTI: HC $1.00/MF $0.50 CSCL 03B

A government report on Argentina's space research, in cooperation with NASA, covers the present status and future projects in the field of high-altitude measurements and earth-based observations, by probe rockets, balloons, and artificial satellites. Emphasis is on measurements in the sporadic E-layer of the ionosphere, including ion, electron, and temperature measurements. Other fields cover experiments with sodium and other luminous clouds ejected from rockets, cosmic radiation, observations of auroras, radioastronomy, meteorology, geodesy, satellite tracking, etc. A list of launchings for the year 1964 is given. Author

N65-32364# Lockheed Missiles and Space Co., Sunnyvale, Calif.

ON THE QUESTION OF USING AN AVERAGE METHOD TO INVESTIGATE PERTURBED SATELLITE MOTION

L. D. Nikolenko [1965] 7 p refs Transl. into ENGLISH from Prikl. Mekhan. i Tekhn. Fiz. (USSR), v. 1, no. 6, 1965 p 71–77

The averaging method of Krylov-Bogoliubov, developed for systems with rapidly rotating phases is applied to an analytical investigation of the motion of an orbiting vehicle in a non-central field of earth's gravitation under the effect of a small radial force. Formulas are found for the calculation of the fundamental periods of motion of the orbiting vehicle. The motion of the orbiting vehicle is described herein in conformity with the method proposed i.e., the motion of the orbit plane is considered as a solid body and the satellite motion in an orbit different from the elliptical is determined in this plane. Author

N65-32367# Lockheed Missiles and Space Co., Sunnyvale, Calif.

ON A METHOD OF CONSTRUCTING SOLUTIONS OF THE EQUATIONS OF PLANE PERTURBED MOTION OF CELESTIAL MECHANICS

V. V. Laricheva and M. V. Rein [1965] 10 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 3, no. 3, 1965 p 359–367

General solutions are found approximately for a number of perturbed systems by using a theory expounded earlier. The problem of selecting the control effect realizing stable motion of a point along a given spiral trajectory is solved. Studied in detail is a class of perturbed systems possessing a logarithmic spiral as particular solution. Author

N65-32369# Lockheed Missiles and Space Co., Sunnyvale, Calif.
COMPUTATION OF THE PARTIAL DERIVATIVES OF THE MOTION CHARACTERISTICS BY MEANS OF INITIAL CONDITIONS
V. G. Khoroshavtsev [1965] 6 p ref Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 3, no. 3, 1965 p 374–379

A simplified algorithm is presented for the computation of the value of the partial derivatives of satellite motion. The algorithm may be used in problems associated with the determination of the orbit of artificial earth satellites or the estimation of the accuracy of such a determination. In the derivation it was assumed that the motion of the satellite occurs in a Newtonian central force field and that the satellite mass is negligibly small compared to the mass of the attracting center. E.E.B.

N65-32393# Gt. Brit. Dept. of Scientific and Industrial Research.
WORLD DATA CENTRE C: ROCKETS AND SATELLITES, LIST OF REPORTS AND REPRINTS RECEIVED DURING THE PERIOD 1 JANUARY–30 JUNE 1965
[1965] 20 p refs

A bibliography containing approximately 250 titles concerning recent space research is presented. The reports pertain to satellite probes, orbits and flight paths, tracking, data recovery, instrumentation, interplanetary probes, gravitational fields, magnetic fields, terrestrial and space radiation, atmospheric properties, radiowave propagation, meteors and meteorites, interplanetary dust and tektites, biological and medical problems, astronomy, and plasma physics. J.M.D.

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N65-31265 Naval Ordnance Lab., White Oak, Md.
HASP—A FAMILY OF U. S. NAVY METEOROLOGICAL ROCKETS
M. J. Parker *In* Arg. Natl. Comm. on Space Res. Interam. Symp. on Space Res., Proc., Vol. 1 1965 20 p (See N65-31263 20-30)

The High Altitude Sounding Projectile (HASP) family of meteorological rockets is described. The rockets consist of a separable head which is powered by a 3-inch solid propellant rocket motor. Most members carry copper chaff as the payload which is ejected and tracked by radar to determine wind speed and direction. A metallized parachute, a self-inflating Robin type sphere, and an instrument package are other payloads in the HASP family. R.N.A.

N65-31492# Rocketdyne, Canoga Park, Calif.
TASK IV: INTEGRATED PAYLOAD PACKAGE CONCEPT STUDY Final Program Progress Report for Product Engineering, 1 Jan. 1964–1 Apr. 1965
1 May 1965 348 p refs
(Contract AF 04(694)-110)
(R-5652-4P; SID-65-387-1; SID-65-387-2; AD-466658)

The Integrated Payload Package (IPP) Concept Study investigations led to the development of: (1) methods to analyze the aerodynamic interactions and performance capabilities of nose steering reaction control systems, (2) analytic and simulation techniques which led to the determination of the dynamic response of ICBM vehicles utilizing an IPP unit, and (3) IPP/nose steering design criteria established by a system analysis and design of both liquid and solid propellant booster typical ICBM vehicles. Detailed parametric analyses as well as studies of jet impingement, trajectory shaping, and data verification establish a number of conclusions as to the applicability of this system to stabilize and control, the propulsion characteristics best suited to this concept, and the areas of potential application of the IPP concept to ICBM vehicles. Recommendations are made of the investigation areas where further analysis of test data is required. An appendix contains the aerodynamic parametric data and the analog and digital computation equations and procedures used in the stability and control analysis. Author

N65-31529# Boeing Co., Seattle, Wash. Aero-Space Div.
PERFORMANCE AND COST ANALYSIS OF ADVANCED ROCKET AND AIRBREATHING LAUNCH SYSTEMS
[1965] 33 p refs Presented at the 5th European Space Flight Symp., Munich, Jul. 19–22 1965

This paper presents a comparison of the performance and cost of advanced rocket and airbreathing launch systems designed to consistent mission criteria for crew shuttle and logistics support to near-Earth space stations. Preliminary designs are described that include rocket propulsion, airbreathing propulsion, various combinations of reusable and expendable stages, and horizontal and vertical takeoff modes. The sensitivity of system performance and cost to factors such as stage mass fraction, number of reuses, refurbishment rate, and size of the launch program is analyzed and compared. Author

N65-31573*# Sperry Gyroscope Co., Carle Place, N. Y.
DEVELOPMENT OF LAUNCH VEHICLE MALFUNCTION EFFECTS MODEL
Washington, NASA, Aug. 1965 104 p refs
(Contract NAS8-11229)
(NASA-CR-288) CFSTI: HC $4.00/MF $0.75 CSCL 14D

Mathematical relationships relating malfunction and remedial actions to their effects on crew safety and mission success were derived and are presented as a series of mathematical models and computational procedures. The application of these techniques to the Saturn V launch vehicle has demonstrated that the large volume of reliability and failure effects data, typical of a complex multistage launch vehicle, can be assimilated, processed, and used effectively to assure that the Rocket Engine Analyzer and Decision Instrument system design considers these data in a proper perspective. R.N.A.

N65-31831# Lockheed Missiles and Space Co., Sunnyvale, Calif.
GEMINI AGENA TARGET VEHICLE Program Progress Report, Oct. 1964
20 Nov. 1964 50 p
(Contract AF 04(695)-129)
(LMSC-A605200-2; AD-462845)

Reported is the current status of the Gemini Agena Target Vehicle (GATV) Program. Presented are data on: hardware and testing, studies on the probability of meteorite damage, digital computer studies to determine changes to the Agena flight control system required to provide spacecraft GATV bending stability in the docked configuration under primary

propulsion system flight, engine thrust transient studies, command programmer studies, the Atlas/Agena coordination meeting, the Extra Care Program (supervisory orientation and recognition of outstanding performance), documentation (interface and detail specifications), product assurance and reliability studies, and the vehicle schedule status of Gemini Agena target vehicle-5001. S.C.W.

N65-31891# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Techonology Div.
THE COMMUNICATIONS SATELLITE
Mo King and Fan Ping 7 Jul. 1965 10 p Transl. into ENGLISH from Kexue Dazhone (China), no. 7, 1963 p 6-7, 21
(FTD-TT-64-961/1+2+3+4; AD-466525)

Economic significance, practical considerations, and technical possibilities of communications satellites are discussed in general terms. Considered are relay stations in outer space; and passive reflecting, active communications, synchronous communications, and low orbit satellites. Three modes of electromagnetic wave transmission are illustrated; and a world-wide communications system formed by three synchronous satellites in orbits at an altitude of 35 800 kilometers is discussed and illustrated. Since it is difficult to launch satellites at this high altitude, the use of a larger number of satellites in orbit closer to the earth is considered. M.W.R.

N65-31936# Inter-Range Instrumentation Group, White Sands Missile Range, N. Mex.
METEOROLOGICAL ROCKET NETWORK FIRINGS. VOLUME XXXVI: AUGUST 1964 FIRINGS Data Report
Mar. 1965 263 p
(IRIG-109-62; AD-462758)

Meteorological rocket sounding data, collected at White Sands Missile Range from ranges around the world, are presented. Charts and graphs of wind and temperature measurements are included for all firings for August 1964. Radiosonde observations nearest the time of firing are reported, and a list of reporting points and codes is also given. M.R.W.

N65-32089*# Planning Research Corp., Los Angeles, Calif.
RELIABILITY ASSESSMENT OF THE 1964 MARINER MARS SPACECRAFT
J. D. Andrew, E. E. Bean, and N. E. Chudacoff 22 Jul. 1963 371 p refs Prepared for JPL
(Contract JPL-950445)
(NASA-CR-59375; PRC-R-362) CFSTI: HC $7.00/MF $2.00 CSCL 22B

The findings of a numerical exercise of the reliability model of the Mariner Mars spacecraft are presented along with detailed reliability representations of the spacecraft subsystems. Conclusions are drawn regarding pertinent aspects of the reliability of this complex system, which is scheduled for launch in late 1964. A set of carefully apportioned worth functions that quantitatively rank the project objectives is presented, and these are employed to weight, in a rational manner, the probabilities of successfully accomplishing the stated objectives. From this a reliability figure-of-merit is derived. Selected events and functions of particular interest and significance are separately investigated, and the corresponding classical reliabilities are computed. Complete data on failure rate estimates and parts complements are presented. Author

N65-32148# Academy of Science, Paris (France).
AN AEROSPACE TRANSPORTER SYSTEM
Maurice Roy [1965] 17 p refs Transl. into ENGLISH from French

This lecture reviews the concept of an aerospace transporter system. The concept is defined and its utilization discussed. It is concluded that: (1) The undertaking to establish an aerospace transporter system by 1980 to 1985 calls for the close and active association of the financial and technical resources of several European nations; and (2) The development offers Europe the unique opportunity of powerfully entering into action in the space field in the form of a fruitful and original technical policy. E.E.B.

N65-32171*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
VOYAGER DESIGN STUDY. VOL. I: DESIGN SUMMARY
15 Oct. 1963 109 p
(Contract NASw-696)
(NASA-CR-58846; DOC.-63SD801) CFSTI: $4.00/MF $0.75 CSCL 22B

Results are given of a conceptual design study for a Voyager spacecraft to perform orbiter/lander missions to Mars and Venus. A system is recommended in which the following factors were considered: (a) the mission requirements, (b) the launch vehicle capability, (c) the balance between orbiter and lander scientific equipment weights and mission values in conjunction with the reliability studies, (d) the use of energy-saving eccentric orbits to deliver maximum scientific equipment, and (e) the provision for adequate power, guidance, and communication capabilities with appropriate application of redundancy and back-up modes at critical junctions in each subsystem. C.T.C.

N65-32217# Library of Congress, Washington, D. C. Aerospace Technology Div.
VOSKHOD-1 AND VOSKHOD-2 FLIGHTS Surveys of Soviet-Bloc Scientific and Technical Literature
8 Jul. 1965 32 p refs Review article
(ATD-P-65-46; AD-618388)

The manned flights of the Voskhod-1 and Voskhod-2 are described in detail. Biographical sketches are given of the astronauts, and a brief summary is included of the highlights of their accomplishments. C.T.C.

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N65-31443# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
ANALYSIS OF SHEAR PINS UNDER SINGLE SHEAR
P. E. Duffy Nov. 1964 19 p
(Contract W-31-109-ENG-52)
(KAPL-M-6422(SEV-3))

A shear pin is analyzed as a beam on an elastic foundation. It is shown that for commonly used materials, maximum pin length need not be any greater than twice its diameter. Non-dimensional design curves are given for pin bending stress, maximum bearing stress, lug stress and pin deflections. Also the effect of tapering or chamfering the pin hole is given. Author

N65-31499# Catholic Univ. of America, Washington, D. C.
FINITE DEFORMATIONS UNDER PRESSURIZATION IN AN INFINITELY LONG, THICK-WALLED, NONLINEARLY VISCOELASTIC CYLINDER IDEALLY BONDED TO A THIN ELASTIC CASE—PRELIMINARY REPORT Quarterly Progress Report
J. H. Baltrukonis Jun. 1965 39 p refs
(Contract AF 04(611)-10388)
(QPR-2; AD-467591)

A constitutive equation for a nonlinearly viscoelastic, incompressible, Mooney-Voigt material is developed. Use is made of the equation to arrive at a differential equation for the quasistatic finite-deformational response under internal pressurization of an infinitely long, thick cylinder of a nonlinearly viscoelastic material bonded to a linearly elastic thin case. Author

N65-31505# Consultants in Engineering Science (Conesco), Cambridge, Mass.
THE BARRIER ATTENUATION INTRODUCED BY A VERTICAL WALL
C. McDonnell, J. V. Velletri, A. W. Starbird, and J. F. Batter Fort Belvoir, Va., Protective Structs. Develop. Center, 1 Sep. 1964 62 p refs
(Contract DA-18-020-ENG-3096)
(PSDC-TR-15; AD-617524)

A series of tests designed to evaluate the attenuation introduced by a vertical wall adjacent to a horizontal field of contamination is described. The variation of the resultant attenuation with height is found to agree well with theory. Actual attenuation values measured are higher than those theoretically predicted by an amount equivalent to approximately eight percent of the wall thickness. Author

N65-31570*# ARA, Inc., West Covina, Calif.
CONCEPTS OF MULTIPLE-IMPACT STUDY OF ENERGY ABSORPTION
Washington, NASA, Aug. 1965 159 p refs
(NASA-CR-273) CFSTI: HC $5.00/MF $1.00 CSCL 20L

An attractive new concept of energy absorbing devices incorporating cyclic straining of materials is described. Devices of this type are of particular interest for space applications such as landing impact, and offer multiple-impact capability as well as energy absorption efficiencies greatly exceeding values attainable with other existing devices. Results of an 18-month research program to investigate this concept are presented. Basic principles are discussed and analytical methods for predicting the characteristics and behavior of cyclic strain energy devices are developed. Flow and fatigue behavior of materials is summarized in relation to performance and design. A cyclic torsion apparatus for studying materials under cyclic straining is described and data for several promising materials is presented. The design, construction, and testing of two promising cyclic strain energy impact devices are described. The test results demonstrate the feasibility and potential of this concept.
Author

N65-31636# Massachusetts Inst. of Tech., Cambridge. Metals Processing Lab.
DEFORMATION PROCESSING OF ANISOTROPIC METALS Progress Report, 1 Sep.–31 Oct. 1964
D. H. Avery and W. A. Backofen Jan. 1965 6 p
(Contract NOw-65-0124-d)
(PR-2; AD-611832)

Experimental yield loci and pole figures are presented for four alpha titanium alloy sheets as part of a continuing study on the deformation processing of anisotropic metals. The pole figures exhibited a wide range of crystallographic textures ranging from a tight texture about the sheet normal in 1/16 inch Ti–4 Al–1/4 O_2 through a split texture along the transverse direction in 3/16 inch Ti–5 Al–2.5 Sn, to a texture with the basal plane normals concentrated about transverse direction in 3/16 inch Ti–5 Al–2.5 Sn, to a texture with the basal plane normals concentrated about the transverse direction in 1/16 inch RC-70 Ti. Values for the incremental plastic strain ratio (R value) in the rolling and transverse directions are figuratively shown as a function of strain. There is a clear relation to texture. Figures are also presented on experimental yield loci, loci calculated from uniaxial R values and yield strengths by the Hill theory, and calculated loci for isotropic material. Agreement with the Hill theory is good except for the 1/16 inch Ti–4 Al–1/4 O_2 material. R.N.A.

N65-31644# David Taylor Model Basin, Washington, D. C. Acoustics and Vibration Lab.
THREE-DIMENSIONAL (BEAM-SHELL-SPRUNG BODY) VIBRATION ANALYSIS OF NS SAVANNAH
Ralph C. Leibowitz and Robert G. Schwendler Apr. 1965 135 p refs
(DTMB-1728; AD-618673)

The normal modes of coupled vertical, transverse, and longitudinal flexural vibrations and the steady-state damped response were calculated by means of a passive electrical-analog computer for surface ship NS SAVANNAH using a three-dimensional (beam-shell-sprung body) analysis similar to that applied to aircraft. This ship was selected as a case study because of the many test results, data, and calculations available for this ship. Vertical flexural vibrations based upon beam theory were also computed by a digital computer. To demonstrate the techniques involved in making a three-dimensional analysis, the methods and data used in the calculations and the results obtained are presented. Results show that significant reductions in vibration amplitudes can be achieved by such methods as damping or inertia coupling, which directly affect the sharpness of the structural resonance peaks. Author

N65-31697# Lockheed Missiles and Space Co., Sunnyvale, Calif.
PROPAGATION AND INTERACTION OF ELASTIC-PLASTIC LOADING WAVES IN A FINITE ROD
G. V. Litvinov [1964] 6 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), no. 5, 1964 p 108–111

An analytical solution is presented for the problem of longitudinal impact loading of a finite rod, one of whose ends is clamped rigidly and the other suddenly receives a constant velocity. The method of approximations is used for the derivation. E.E.B.

N65-31701# Ammann and Whitney, New York.
SUPPORTING STUDIES TO ESTABLISH SAFETY DESIGN CRITERIA FOR STORAGE AND PROCESSING OF EXPLOSIVE MATERIALS. SUMMARY OF ONE-THIRD SCALE REINFORCED CONCRETE SLAB TESTS Interim Report No. 1
E. Cohen and N. Dobbs Dover, N. J., Picatinny Arsenal, Jun. 1965 128 p refs
(Contract DA-28-017-AMC-423(A))
(PA-TM-C-1; AD-617614)

The results of 40 explosive tests of one-third-scale reinforced concrete slabs are presented. The purposes of these tests included the determination of the validity of one-third scaling, development of photographic techniques for recording velocities of concrete fragments, and evaluation of slab response. The major effort was directed toward the evaluation of slab response. Of twenty slabs tested, nine failed while the remainder stayed intact. Damage to those slabs that stayed intact varied from slight to heavy where the latter term describes incipient failure condition. Failure usually occurred in one of two ways, either by total disintegration of the panel or by splitting in half of the slabs. Comparison of the overall results of these tests indicates that increasing the amount of reinforcement and the addition of structural steel in combination with concrete tends to decrease the fragment velocities. E.E.B.

N65-31705# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
THE THEORY OF HYPERVELOCITY IMPACT Annual Status Report
J. K. Dienes, W. E. Johnson, and J. M. Walsh 28 Jun. 1965 114 p refs
(Contract DA-04-495-AMC-116(X); ARPA Order 71-62)
(GA-6509; AD-617540)

The three principal areas of activity—1. Numerical solutions of problems in impact, 2. Code development for solving impact problems, and 3. Analytical work on the theory of the impact process—are reviewed, utilizing wherever possible cited papers which have been published during this past year as part of the project work. The investigations covered in these papers are described only briefly in the present status report, familiarity with or availability of the original documents being assumed. The major part of the present discussion is devoted to a status report of unfinished work on the problem of computing strength-dependent and viscous impact flows. A computer program is described for generalizing Eulerian hydrodynamic codes to include these effects and sample calculations are given. Author

N65-31708# Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics.
ON THE MAXIMUM THERMOELASTIC STRESS AND DEFLECTION IN A BEAM OR PLATE Technical Report No. 27
Bruno A. Boley Jan. 1965 30 p refs
(Contract Nonr-4259(07))
(CU-27-65-ONR-4259(07)-CE; AD-617407)

It is shown in this paper that the thermal stress in a beam or plate cannot exceed the value $k\alpha E\Delta T$, where ΔT is the maximum instantaneous temperature excursion in a cross-section, and k is a coefficient dependent on the shape of the cross-section. A simple general formula for k is found, and results for several special cases of practical interest are given. For rectangular beams (suitably oreinted) and for plates, for example, $k = 4/3$. For any section, $k = 1$ if the thermal moment is zero; simplifications also occur if the thermal force is zero. The corresponding results for beam deflections are also carried out: the maximum deflection cannot exceed the value $k_\delta k_\delta \alpha L\Delta T$, where k_δ and k_δ are coefficients depending respectively on the cross-sectional shape and on the end-conditions. For example, for a rectangular beam $k_\delta = 3/4$ and for a simply-supported beam $k_\delta = 1/8$. Author

N65-31710# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ON THE THEORY OF SHALLOW SANDWICH SHELLS OF NONSYMMETRIC CROSS-SECTION OF ORTHOTROPIC MATERIALS
A. Duda [1965] 8 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. I: Mat. i Mekhan. (Moscow), No. 1, 1965 p 88–95

Stresses and moments are considered for a shallow sandwich shell of nonsymmetric cross section with constant curvatures of the middle surface. It is assumed that the coordinate lines coincide with the principal lines of curvature of the middle surface of the filler and that all three layers of the shell contain different orthotropic materials. Principal directions of orthotropy coincide with the coordinate lines. Fundamental differential equations and boundary conditions of the shell are developed. Equations are found for the contact of the layers in the shell, and static boundary conditions are determined when the shell is deformed along its reinforced edges. M.W.R.

N65-31720# David Taylor Model Basin, Washington, D. C. Structural Mechanics Lab.
INELASTIC BUCKLING TESTS OF RING-STIFFENED CYLINDERS UNDER HYDROSTATIC PRESSURE
Lance Boichot and Thomas E. Reynolds May 1965 40 p refs
(DTMB-1992; AD-617337)

A series of small machined aluminum models were collapsed under external hydrostatic pressure to study the inelastic buckling of near-perfect ring-stiffened cylinders made of strain-hardening materials. The predominant modes of failure were general instability and axisymmetric shell buckling. Comparisons of test results with the analyses of Lunchick, Krenzke, and Kiernan show promising correlation but additional data would be needed for a complete evaluation. High banding stresses near frames did not noticeably affect axisymmetric shell buckling strength. The presence of frame fillets, however, caused a significant increase in general instability strength although bending stresses in the absence of fillets were relatively low. Author

N65-31763# Southwest Research Inst., San Antonio, Tex.
STUDIES OF THE FATIGUE STRENGTH OF PRESSURE VESSELS. 1: CYCLIC PRESSURE TEST OF LARGE SIZE PRESSURE VESSELS. 2: LOW CYCLE FATIGUE TESTING OF ONE-HALF SCALE MODEL PRESSURE VESSELS. 3: EFFECT OF WELD DEFECTS ON THE FATIGUE STRENGTH OF A 302B STEEL
A. G. Pickett, W. R. Schmidt, S. C. Grigory, A. R. Whiting, and H. C. Burghard 21 Sep. 1964 28 p
(Contract AT(11-1)-1228)
(SwRI-1228-37; SwRI-1228-38; SwRI-1228-39)

Recent developments in a study of factors relating to prediction of pressure vessel strength and service life are reported. Low cycle fatigue testing of a one-half scale model pressure vessel continued successfully for 227 685 cycles before leaks and cracks appeared along the weld seam. Fatigue cycling and nondestructive testing was performed on nozzle models; ultrasonic indication and crack length data are plotted over 41 cycles; stress and strain observations are given, along with measurements of transverse and longitudinal bending deflection. Fracture surfaces in steel weld-defect specimens subjected to fatigue testing are shown in fractographs. J.M.D.

N65-31793# Southwest Research Inst., San Antonio, Tex.
A THEORETICAL AND EXPERIMENTAL STUDY OF STRUCTURAL VIBRATION CHARACTERISTICS OF SUBMERGED HYDROFOILS. PHASE III-A: VIBRATION CHARACTERISTICS OF SEVERAL FULL-SCALE HYDROFOIL CRAFT
Jack T. Irick Dec. 1964 73 p refs
(Contract N600(167)60477(X))
(TR-1; AD-454928)

The objective of this study is to determine and evaluate existing measured data on dynamic structural characteristics of several hydrofoil craft. It was found that a very small amount of data has been reported and that no comprehensive program to obtain such data is being planned for any of the hydrofoil craft considered. Certain of the procedures used in the design of these craft are also discussed. Author

N65-31820# Drexel Inst. of Tech., Philadelphia, Pa. Dept. of Metallurgical Engineering.
FRACTURE OF METALS DURING DEFORMATION PROCESSING UNDER CONDITIONS OF HOT WORKING Progress Report, Feb. 12–Apr. 12, 1965
J. V. Mullin and G. E. Dieter 26 Apr. 1965 7 p
(Contract NOw-65-102-d)
(PR-3; AD-464856)

Study continued on the ductile fracture of metals under conditions of stress, temperature, and strain rate. The design and fabrication of the stress testing device were completed. Proof tests were conducted with inconel specimens at room temperature to determine the maximum torque needed to cause

fracture. The first tests were conducted from a dead stop condition so that the motor could not reach maximum speed before the specimen was loaded. This was remedied by allowing the motor to idle first and then engaging the clutch system to apply the load. In addition, the fracture surfaces were badly distorted from rubbing against one another. Therefore, a drop weight system was devised to disengage the surfaces. The torque calibration for the instrumented strain gage section of the drive shaft was completed. Proof tests show that at a nominal strain rate of 65 inches per inch per second the fracture occurs in less than one tenth of a second after the load is applied. R.N.A.

N65-31853# Bettis Atomic Power Lab., Pittsburgh, Pa.
INELASTIC BUCKLING OF LONG AXIALLY COMPRESSED CURVED PLATES
D. S. Griffin Jul. 1965 18 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-469) CFSTI: $1.00

Differential equations are obtained for the inelastic deflections of long curved plates using small deflection theory. The usual assumption of incompressibility of material ($\mu = 1/2$) is avoided by making Poisson's ratio stress dependent beyond the elastic range. Buckling loads are obtained for both clamped and hinged edge conditions assuming a symmetrical mode typical of plates that buckle inelastically. In addition, axial buckling solutions, more rigorous in terms of the variable Poisson's ratio, are obtained for circular cylinders and flat plates with clamped and hinged edge conditions. Author

N65-31856# Atomics International, Canoga Park, Calif.
ENVIRONMENTAL LABORATORY AND EQUIPMENT
W. E. Gauvain 9 Apr. 1964 75 p
(Contract AT(11-1)-GEN-8)
(NAA-SR-MEMO-9438)

A description of the Atomics International Environmental Laboratory, its test equipment, and the testing techniques used there is presented. Particular emphasis is given to vibration, shock, acceleration and static testing, and to the unique test methods developed by the laboratory staff. Author

N65-31859# Lockheed Missiles and Space Co., Sunnyvale, Calif.
LOCAL STABILITY OF SANDWICH SHELLS OF REVOLUTION
E. I. Grigoliuk and P. P. Chulkov [1964] 12 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), no. 6, 1964 p 78–88

Reported is an investigation of the linearized stability of sandwich shells of nonsymmetric structure with a hard filler under combined loading. Presented are results of a theoretical analysis of shells of revolution, spherical, cylindrical, and conical shells. S.C.W.

N65-31860# Aeronutronic, Newport Beach, Calif. Research Labs.
A MECHANICS ANALYSIS OF ARMOR PENETRATION
Donald F. Adams and Stephen W. Tsai 8 May 1964 27 p refs
(Contract DA-04-495-AMC-93(R))
(U-2600)

A mathematical model has been established and equations of motion have been derived to predict the behavior of a projectile penetrating an armor material. Both velocity-independent and inertial forces have been taken into account as well as the geometry of the projectile. Variations in resisting forces during projectile entrance into and exit from the panel are also considered. The results of this theoretical analysis agree well with experimental data throughout the ballistic velocity range for all non-metallic materials considered. Indications are that the analysis will also be valid for other materials and at higher velocities as well. Author

N65-31900# Stanford Research Inst., Menlo Park, Calif.
THEORETICAL STUDIES OF DETONATION Quarterly Progress Report, Mar. 1–May 31, 1965
Michael Cowperthwaite 17 Jun. 1965 6 p
(Contract DA-04-200-AMC-916(X))
(QPR-2; AD-466964)

Study of the hydrodynamic characteristics of one-dimensional shock initiation of detonation in condensed media is continuing. It was found that the initiation of an overdriven or C-J steady state wave with no transient phase is only possible if the path of the initiating piston is a particle path of the steady state wave. The probability of initiation depends not only on the difference between initial values of the energy release rate and the loss terms which determine whether the shock initially accelerates or decays, but also upon the rate at which these terms change as the wave developes. Furthermore, the initiation probability depends on the shape of the initiating pulse, as well as on the initial shock strength. J.M.D.

N65-31984# Lockheed Missiles and Space Co., Sunnyvale, Calif.
FUNDAMENTAL RELATIONSHIPS OF THE ENGINEERING THEORY OF RIBBED SHELLS
E. S. Greben' [1965] 10 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. (Moscow), no. 3, 1965 p 124–130

The stress and strain state of a ribbed shell is considered on the basis of hypotheses used in engineering theories of elastic smooth shells and rod systems. It is assumed that the ribs resist only axial strain and bending in a direction normal to the middle surface of the shell. Delta functions are used in formulating the problem, and with their aid, the concept of generalized stresses and moments is introduced and elasticity relationships are established. The equilibrium differential equations of an element of the ribbed shell and the static boundary conditions are derived from the principle of possible displacements. The case of a circular cylindrical ribbed shell is considered, for which equilibrium equations are derived in displacements. A numerical example of the computation of a circular cylindrical shell reinforced by three ribs is presented. R.N.A.

N65-31985# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ON THE STABILITY OF SANDWICH SHELLS WITH ELASTIC-VISCOUS FILLER
Kh. M. Mushtari and A. G. Teregulov [1964] 7 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), no. 6, 1964 p 119–124

Equations of the local buckling for sandwich shells with a light filler are derived. Problems of the stability of cylindrical and spherical sandwich shells of symmetrical construction are solved. It is assumed that the carrying layers of the shells are fabricated from material subject to Hooke's law and the filler is of a material obeying a linear elastic-viscous strain law. Author

N65-31986# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ON THE QUESTION OF CYCLICALLY SYMMETRIC DEFORMATION OF VARIABLE THICKNESS SHELLS OF REVOLUTION
Ia. M. Grigorenko [1965] 5 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Ukr. RSR, (Kiev), no. 3, 1965 p 317–322

The elastic deformation of a thin closed shell of revolution under cyclically symmetric loading relative to the axis of revolution is considered. A complete system of equations for the forces, moments, strains, and displacement is derived. From these expressions the boundary conditions for the system may be formulated in both the stress-moments and in displacements. M.R.W.

N65-31987# Lockheed Missiles and Space Co., Sunnyvale, Calif.

SIMPLE EDGE EFFECT AND PARTITION OF BOUNDARY CONDITIONS IN THE LINEAR THEORY OF THIN SHELLS

K. F. Chernykh [1965] 11 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. (Moscow), no. 1, 1965 p 89–98

Combinations of complex, static, and strain boundary quantities independent of edge effect are derived. A solution of the general boundary value problem is developed in two steps. The first is the solution of the basic degenerate problem with its boundary conditions. The second step is the imposition of the edge effect on the obtained solution. The edge effect is determined not by normal deflection and the angle of rotation of the shell edge, but by quantities characterizing the tangential explanation of the edge effect phenomenon. A simplified version of the fundamental relationships is presented for practical use. Separated conditions are obtained for the elastic conjugate. Coefficients of pliability of the edge are introduced and simple expressions are given for the stresses. The strain character of the pliability coefficients is completely clarified. R.N.A.

N65-32015# Lockheed Missiles and Space Co., Sunnyvale, Calif.

NEW METHOD OF DETERMINING THE POSTCRITICAL EQUILIBRIUM OF A CYLINDRICAL SHELL UNDER AXIAL COMPRESSION

V. K. Trincher [1965] 7 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. I: Mat. i. Mekhan. (Moscow), no. 1, 1965 p 76–82

The postcritical equilibrium state of a cylindrical shell under axial compression was determined from approximations for the formation of local dents on the shell. It was assumed that the flexures of the local dents were concentrated around some ribs, and that the shapes of the smooth regions of the dents were similar to cylindrical surfaces because of the absence of transverse loading on them. G.G.

N65-32019# Aeronautical Research Council (Gt. Brit.)

STRUCTURAL DAMAGE CAUSED BY IMPULSIVE LOADS: A THEORETICAL ANALYSIS

E. H. Mansfield London, HMSO, 1965 35 p refs Supersedes RAE-TN-Struct-294, ARC-26156; see X64-16605

(ARC-R&M-3408; RAE-TN-Struct-294; ARC-26156) HMSO: 14s

A general theoretical technique is presented for the estimation of structural damage caused by impulsive loads. The technique, though approximate, takes account of differences that may exist between the elastic and plastic modes of deformation. A detailed analysis, with some numerical results, is presented for the case when the impulsive load is a uniformly distributed pressure whose magnitude varies time-wise as a rectangular pulse. Author

N65-32045*# Oklahoma State Univ. Research Foundation, Stillwater.

HYPERVELOCITY IMPACT OF MICROPARTICLES Quarterly Progress Report No. 18, Jan. 1–Mar. 30, 1965

F. C. Todd and B. A. Sodek, Jr. [1965] 227 p

(Contract NASr-7)

(NASA-CR-64535) CFSTI: HC $6.00/MF $1.25 CSCL 20K

The analytical and experimental phases of this project are concerned with the phenomena that occur with the hypervelocity impact of microparticles on a massive target, which may be solid, or layered. The physical mechanisms in the hypervelocity impact of a microparticle were investigated to ascertain the momentum and the energy transferred from the particle to the target, and, possibly, to estimate the density of the incident microparticles. The curves of the computer calculations are presented with minor smoothing of the numerical results. The raw data are presented so the amount and manner of smoothing these results at a later date will be apparent. R.W.H.

N65-32059# Whittaker Corp., San Diego, Calif. Narmco Research and Development Div.

OPTIMUM FILAMENT DIAMETERS Annual Summary Report, 1 Oct. 1963–15 Sep. 1964

Jerome Jobaris 15 Sep. 1964 34 p refs

(Contract NObs-86347)

(AD-605552)

A study is made to determine if the compressive strength of unidirectional 5-mil glass fiber composites, as demonstrated by NOL ring tests, could be realized in a more complex state of stress as experienced in the hull of a submersible structure. The realization of the compressive potential of 5-mil fiber composites would lead to highly efficient underwater vehicles. Initially the material properties of 5-mil fiber composites for three different volume percentages of glass were determined. From these data, the cylinder test specimens were designed. A total of seven cylinders were fabricated and tested to failure in hydrostatic compression. Two additional hydrostatic collapse tests were performed on sections salvaged from a collapsed specimen. The collapse pressures of the cylinders indicated that the 5-mil fiber composites did not yet attain their compressive strength potential. Composite compressive stress levels of 170 000 psi were achieved in the fiber direction, compared to stress levels of 250 000 psi from NOL ring data with identical resin content. Author

N65-32152*# Northwestern Univ., Evanston, Ill. Dept. of Civil Engineering.

ON THE DESTABILIZING EFFECT OF DAMPING IN NONCONSERVATIVE ELASTIC SYSTEMS

G. Herrmann and Ing-Chang Jong [1964] 49 p refs Submitted for Publication

(Grant NsG-605)

(NASA-CR-59356) CFSTI: HC $2.00/MF $0.50 CSCL 20K

The destabilizing effect of linear viscous damping in a nonconservative elastic system is investigated by studying the roots of the characteristic equation in addition to the stability criteria and by introducing the concept of degree of instability. A generic relationship between critical loadings for no damping and for slight damping as well as vanishing damping is established. It is found that while the presence of small damping may have a destabilizing effect, proper interpretation of the limiting process of vanishing damping leads to the same critical load as for no damping. Author

N65-32155*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

PRINCIPLES AND PRACTICES FOR SIMULATION OF STRUCTURAL DYNAMICS OF SPACE VEHICLES

George W. Brooks [1964] 47 p refs Presented at the VPI Conf. on the Role of Simulation and Space Technol., Blacksburg, Va., 17–21 Aug. 1964

(NASA-TM-X-54809) CFSTI: HC $2.00/MF $0.50 CSCL 20K

The paper discusses the philosophy and principles for the selection and design of dynamic models for analysis of structural dynamics of space vehicles. Subjects treated include similitude, model scaling, applications of modeling to launch vehicles and spacecraft, and considerations relative to damping and model support systems. An appendix is included which summarizes the various dimensionless ratios used in aerospace flight. Author

N65-32160*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SIMULATION OF STRUCTURAL DYNAMICS OF SPACE VEHICLES DURING LAUNCH
H. L. Runyan [1964] 43 p refs Presented at the Conf. on the Role of Simulation in Space Technol., Blacksburg, Va., 17–21 Aug. 1964
(NASA-TM-X-54789) CFSTI: HC $2.00/MF $0.50 CSCL 20K

A study of simulation techniques of importance in the design and operation of launch vehicles is reported, which focuses on dynamic problems from the time of lift-off to the time at which the vehicle leaves the sensible atmosphere. Considered are the following problem areas: buffet and acoustic loads, ground and aloft winds, fuel slosh, control loads during programmed maneuvers, response and loads in the longitudinal direction, and pilot performance. Presented are specific examples of dynamic model testing which consider the problem of gross vehicle vibratory motion, buffeting, and the acoustic problem. S.C.W.

N65-32233# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.
LONG CYLINDRICAL SHELL UNDER CONCENTRATED LOADS APPLIED TO A CENTRAL REINFORCING RING
Arnold Allentuch, Kevin Brady, and Josepy Kempner Apr. 1965 82 p refs
(Contract AF 49(638)-1360)
(PIBAL-680; AFOSR-65-0984; AD-618306)

The stresses and displacements are determined in an infinite circular cylindrical shell reinforced at its midlength by a single frame. Acting at the ends of a diameter of the ring are two self-equilibrating radial forces and moments. Solutions are obtained using the Donnell shell differential equations, the Love-Reissner shell equations and the Flügge shell equations. The numerical results indicate that the three solutions are in excellent agreement. Stress distributions and displacements in the shell are presented along three generators. They indicate high stresses in the neighborhood of the ring. For the values of the parameters considered, these stresses become negligible at a distance from the ring of approximately 0.15 times the radius of the shell so that the length of shell which acts with the ring is 0.30 times the radius of the shell. Stress and displacement distributions in the circumferential direction are also presented for the shell and the ring. Author

N65-32242# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ANALYSES OF DESIGN ELEMENTS UNDER DYNAMIC LOADS (SECTION IV)
V. V. Bolotin 20 May 1965 71 p refs Transl. into ENGLISH from Raschety Na Prochnost'. Teor. i Eksperim. Issledovaniya Prochnosti Mashinostroitel 'nykh Konstruktsiy, Sb. Statey (Moscow), no. 10, 1964 p 211–260
(FTD-MT-64-522; AD-618317)

Methods applied in the statistical dynamics of elastic systems were surveyed, and problems in the mechanics of a deformable solid body requiring application of these methods were examined. The methods described include (1) quasi-static methods, based on probability theory formulas; (2) correlation methods, based on the relationship between correlation or moment functions of input and output parameters; and (3) methods based on kinetic equations, which describe the evolution of distribution functions of random parameters in time. Comparisons showed that the quasi-static methods offer a basic solution to problems in whcih the input parameters are random magnitudes and/or determined functions of time; correlation methods are effective in reference to linear problems; and methods of kinetic equations are applicable to problems related to the Brownian movement theory. Areas in which the methods are competitive are also discussed. M.G.J.

N65-32243# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPROXIMATE EXPRESSION OF THE 3/2 LAW FOR A CONFINED CATHODE IN A HOMOGENEOUS FIELD
I. I. Levintov 15 Jul. 1965 9 p ref Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, v. 85, no. 6, 1952 p 1247-1250
(FTD-TT-65-786/1+2+4; AD-618320)

An approximation expression of the 3/2 law for the magnitude of current density along a beam axis j_r for the case of a current bounded by a volumetric charge with a cathode of radius r having an infinite emission capability and located in a uniform anode field V_a at a distance d given. The initial case where there is no repulsion of the beam under the action of the volumetric charge (r = constant); and the case where the current density j_r and volumetric charge $p(x)$ across the beam cross sections is uniform and the velocity of electrons at the outlet from the cathode is equal to zero are considered. Calculations are worked out for the field strength at the beam axis for explaining the nature of the change of potential along the beam axis. LS

N65-32270*# National Aeronautics and Space Administration, Washington, D. C.
EFFECT OF TANGENTIAL FORCES OF INERTIA ON THE FREQUENCY OF FREE OSCILLATIONS IN A THIN CYLINDRICAL SHELL [O VLIYANII TANGENTSIAL'NYKH SIL INERTSII NA VELICHINU CHASTOTY SVOBODNYKH KOLEBANIY TONKOY TSILINDRICHESKOY OBOLOCHKI]
E. I. Ivanyuta and R. M. Finkel'shteyn Aug. 1965 7 p Transl. into ENGLISH from Issled. po Uprugosti i Plastichnosti, no. 2 (Leningrad), 1963 p 212–215
(NASA-TT-F-9505) CFSTI: HC $1.00/MF $0.50 CSCL 20K

Estimate of the error arising when the inertial forces due to tangential displacements are not taken into account in determining free oscillation frequencies of thin, circular, cylindrical shells. The error arising when r// is equal to, greater than, or smaller than 0.5 is discussed. Author

N65-32275*# National Aeronautics and Space Administration, Washington, D. C.
SELF-SIMILAR PROBLEMS OF PROPAGATION OF TANGENTIAL RUPTURE CRACKS [AVTOMODEL'NYYE ZADACHI O RASPROSTRANENII TRESHCHIN KASATEL'NOGO RAZRYVA]
B. V. Kostrov Aug. 1965 19 p refs Transl. into ENGLISH from Prikl. Mat. i Mekh. (Moscow), v. 28, 1964 p 889–898
(NASA-TT-F-9547) CFSTI: HC $1.00/MF $0.50 CSCL 20K

An examination is made of the plane and spatial problems of unsteady crack propagation in a medium subjected to uniform shear. The plane problem is completely analogous to the problem of Broberg regarding a normal rupture crack, but it is solved by much simpler methods. The concurrent study of plane and spatial cases also has the advantage that several of the intermediate results derived for the plane problem provide a basis for solving the spatial case. Author

N65-32302# General Technology Corp., Elgin, Ill.
MODELS OF YIELDING IN THE VICINITY OF THE ROTATING BAND
R. C. Geldmacher and T. M. Roach, Jr. Sep. 1964 47 p refs
(Contract DA-11-022-ORD-2917)
(TR-1-23; AD-617402)

The purpose of this investigation was to develop a foundation for procedures whereby the shell designer can predict post-yield deflections in shells in the region beneath the rotating band and determine the magnitudes of rotating band pressures for a particular shell–band–gun system. Two models of yielding are discussed. In one model a yield parameter is defined which in effect reduces the thickness of the shell wall as band loading increases. In the other model, a yield parameter is defined which in effect increases post-yield loading in proportion to displacement. Of the two models, the first seems to show considerable promise both as a means of predicting post-yield deflection and as a formulation which can be coupled with formulations for the rotating band and gun to give a solution for the shell–band–gun problem. E.E.B.

N65-32308# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.
THE FLUTTER OF AN INFINITELY LONG CYLINDRICAL SHELL
Earl H. Dowell Jan. 1965 75 p refs
(Grant AF-AFOSR-62-363)
(ASRL-TR-112-3; AFOSR-65-0639; AD-616321)

The aeroelastic stability of an infinitely long, isotropic cylinder with the outer surface exposed to an inviscid flow is re-examined. The cylinder behavior is described by the shell equations of Goldenvieser, while the aerodynamic forces are described by the classical linearized potential theory. It is shown that the critical wavelength for the axisymmetric mode ($n = 0$) is generally small compared to the cylinder radius, while for the asymmetric modes ($n > 0$) it is generally large compared to the radius with it becoming infinite for the first asymmetric mode ($n = 1$). Thus, the infinitely long cylinder model should be useful for $n = 0$, less useful for $n \geq 2$ and inadequate for $n = 1$. An important consequence of the present study is the indication that the aerodynamic loading on the cylinder is of the "slender body" type when the axial wavelength is large compared to the circumferential wavelength. Author

N65-32317# General Electric Co., Cincinnati, Ohio. Advanced Technology Services.
PLANE-STRAIN PLASTIC—VISCOELASTIC DEFORMATION OF A COMPOSITE TUBE
J. P. Yalch May 1964 56 p refs
(Contract AT(40-1)-2847)
(GEMP-288)

A method and an associated computer program are described for calculating during successive time intervals the plastic stress/strain distribution in a long hollow circular composite cylinder subjected to an internal pressure, axial load and having a variable axisymmetric temperature distribution. The computer program (NMPO No. 748) was coded in the FORTRAN II language for the IBM 7090/4 machines. Author

N65-32348# Lockheed Missiles and Space Co., Sunnyvale, Calif.
STABILITY AND POST-CRITICAL DEFORMATION OF LONGITUDINALLY CORRUGATED CYLINDRICAL SHELLS
V. I. Shalashilin [1965] 7 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhn. (Moscow), no. 3, 1965 p 131–135

Nonlinear equations were obtained for shallow shells of corrugated material, and the upper critical loading of longitudinally corrugated cylindrical shells was determined. Here, the post-critical deformations of such shells are investigated and the lower critical loading is determined. The influence of initial deflection is not considered. But since the material of a longitudinally corrugated shell is separated from the middle surface, it is natural to assume that the initial deflection for such a shell plays a considerably smaller part than for a smooth shell. This is verified by the Thielemann results in which the stability and post-critical deformations of orthotropic shells were investigated. Author

N65-32354# Sandia Corp., Albuquerque, N. Mex.
PROJECT SAND FINAL PROGRAM REPORT. VOL. III: DYNAMIC ANALYSIS OF THE SAND SAMPLER FLIGHT
H. R. Vaughn and D. Q. Matejka Sep. 1965 62 p refs
(Proj. SAND)
(SC-RR-65-286) CFSTI: $3.00

A dynamic analysis of the apparent dynamic instability and consequent structural failure of the SAND (Sampler for Aerospace Nuclear Debris) payload is presented. A spin-up rate of five resolutions per second destroyed the sampler payload after 6.7 seconds of operation. Failure was caused by structural overload due to resonance coupling between the payload motion and the first bending mode of the sampling vanes. Safe steady-state operating spin frequencies were calculated that avoided the unsafe resonance zones caused by the payload excitation frequency, the precessional frequency, and the spin frequency. Structural modifications of the vanes were also suggested. It was concluded that the steady-state spin frequency for the existing SAND payload must be in the region of either four or eight cycles per second, because the centrifugal loading limits the spin frequency to 10 cycles per second or less. G.G.

N65-32366# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ON THE EQUATIONS OF ELASTIC VIBRATIONS OF A CAVITY PARTIALLY FILLED WITH FLUID
L. V. Dokuchaev [1965] 7 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), no. 3, 1965 p 149–153

The equations of the elastic vibrations of a thin-walled cylindrical rod with a liquid filler were examined. Later they were the subject of a more detailed analysis. The appropriate equations are generalized to the case of a non-cylindrical rod with a liquid partially filling the cavity of arbitrary configuration, which is analyzed in a different formulation, and the coefficients of these equations are determined in the case of a conical shell with a small aperture angle. Author

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N65-31324 California Univ., Berkeley. Lawrence Radiation Lab.

AVAILABILITY OF THERMODYNAMIC DATA AT HIGH TEMPERATURES FOR METALS AND ALLOYS

Ralph Hultgren *In* APL ICRPG Working Group on the Thermochem., Vol. I Jul. 1965 p 137–140 ref (See N65-31307 20-06)

Due to technical difficulties, most accurate thermodynamic measurements are made at relatively modest temperatures. It was shown that the majority of systems covered are composed of low-melting metals. Of the transition metals, iron, with 12 systems is the best covered; however, an inspection shows that most of these are inadequately measured. The reasons for the neglect are technical. Transition metals are high-melting and easily contaminated especially by elements difficult to detect as C, H, N, and O. R.W.H.

N65-31327 Aerojet-General Corp., Sacramento, Calif. Solid Propellant Research Div.

NEEDS FOR THE THERMODYNAMIC DATA ON HEAVY ELEMENTS AND COMPOUNDS

James P. Coughlin *In* APL ICRPG Working Group on the Thermochem., Vol. I Jul. 1965 p 161–168 refs (See N65-31307 20-06)

The needs for thermodynamic data for heavy elements and compounds fall into two general categories: (1) heavy elements which may be used as nozzle construction materials; and (2) heavy elements which may be used as propellant ingredients for improved performance. Among the elements and compounds of interest in propellant performance are dense inerts such as Hg, and Pb; dense oxidizers such as $Zr(ClO_4)4$, As_2O_5, and NH_4IO_3; and the dense combustible fuels such as Zr, ZrH_2, Hf and U. It was pointed out that for nozzle construction materials, data are needed for carbides, nitrides, borides, and silicides of Ti, Zr, Hf, V, Nb and Ta, as well as for possible corrosion products of these elements. R.W.H.

N65-31390# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.

LIQUID METALS. COLLECTION OF ARTICLES

V. M. Borishanskii, ed. Jun. 1965 156 p refs Transl. into ENGLISH of selected articles from the book "Zhidkie Metalli, Sbornik Statei" Moscow, Gosatomizdat, 1963 p 27–33, 55–138, 150–205

(AEC-TR-6554) CFSTI: $5.00

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N65-31391 Atomic Energy Commission, Washington, D. C. Div. of Technical Information.

RELATION BETWEEN THE COEFFICIENTS OF TURBULENT HEAT AND MOMENTUM EXCHANGE IN THE TURBULENT FLOW OF LIQUID METAL

L. S. Kokorev *In its* Liquid Metals. Collection of Articles Jun 1965 p 1–8 refs (See N65-31390 20-33) CFSTI: $5.00

Experimental and calculated values showing the relation of coefficients of turbulent heat exchange and momentum for the turbulent flows of liquid metals in tubes, and in a rectangular channel are plotted. The calculations are based on an approximate analysis of differential equations for heat transfer and momentum with respect to Prandtl's semi-empirical theory of turbulence. The empirical constants C_1 and C_2 in the treated equations agree with experimental momentum values at $C_1 = C_2 = 1.0$. L.S.

N65-31392 Atomic Energy Commission, Washington, D. C. Div. of Technical Information.

HEAT TRANSFER FOR TURBULENT FLOW IN PIPES FOR LIQUIDS WITH SMALL PRANDTL NUMBERS (Pr < 1) A Short Survey of Theoretical Articles

T. V. Zablotskaya *In its* Liquid Metals. Collection of Articles Jun. 1965 p 9–29 refs (See N65-31390 20-33) CFSTI: $5.00

A survey of approaches to the solution of heat transfer problems for turbulent flow in pipes for liquids with small Prandtl numbers (Pr < 1) is presented. The problem is solved for a given temperature at the wall (t_w = constant), for a given temperature gradient at the wall (q_w = constant), and for variable conditions at the boundary ($t_w \neq$ constant and $q_w \neq$ constant). Calculations are also given for solving the effect of viscosity, and the effect of velocity profile on the turbulent transfer of momentum and heat. A comparison of the different theories with experimental data calculated from the various formulas is graphically presented. Impurity factors, which are known to

affect the character of the thermal process, were not taken into account in the theoretical formulation of the problem. L.S.

N65-31393 Atomic Energy Commission, Washington, D. C. Div. of Technical Information.
HEAT TRANSFER AND HYDRAULIC RESISTANCE IN THE MOTION OF LIQUID METALS IN CIRCULAR TUBES
V. M. Borshanskii, N. I. Ivashchenko, L. V. Kozlova, S. S. Kutateladze, and L. L. Shneiderman *In its* Liquid Metals. Collection of Articles Jun. 1965 p 30–55 refs (See N65-31390 20-33) CFSTI: $5.00

The results of experimental investigations in heat transfer and hydraulic resistance in the turbulent flow of liquid metals in circular tubes are presented in tabulated and graphic form. Heat transfer to heavy and light molten metals is investigated as a function of the rate of flow of the heat transfer agent, Prandtl numbers, thermal flux quantity, tube diameter, and tube length. The influence of wetting agents is studied, and the hydraulic resistance of friction under conditions of isothermal and anisothermal flow of liquid metals in tubes is examined over a considerable interval of change in Reynold's numbers. L.S.

N65-31394 Atomic Energy Commission, Washington, D. C. Div. of Technical Information.
RESULTS OF INVESTIGATION OF HEAT TRANSFER TO SODIUM IN THE REGION OF SMALL PECLET NUMBERS
M. S. Pirogov *In its* Liquid Metals. Collection of Articles Jun. 1965 p 56–71 refs (See N65-31390 20-33) CFSTI: $5.00

Tabulated data showing the distribution of tube wall temperature in experiments designed to investigate heat transfer to sodium in the region of small Peclet numbers, are presented, and the data are constructed in graphic form. Schematic drawings showing the arrangement of thermocouples and heating sections in the experimental installation (a closed heated circuit with forced circulation of sodium) are given, and the method of investigation is described. The maximum deviation of the thermocouple indications from the averaging line of the wall temperature does not exceed 1.2° C, with a deviation of most of the thermocouples of not more than 0.6° C. The results of calculations of heat transfer coefficients (Nusselt numbers) are also graphically shown, and tables are given for temperature profile measurements in the sodium stream. The experimental data obtained on the heat transfer to sodium at Peclet numbers of 19 to 400 and Reynolds numbers of 2300 to 70000 are described with an accuracy of ±15% by the Martinelli-Lyon theoretical equation $Nu = 7 + 0.025\ Pe^{0.8}$. L.S.

N65-31395 Atomic Energy Commission, Washington, D. C. Div. of Technical Information.
DATA ON THE INFLUENCE OF OXYGEN IMPURITY ON HEAT TRANSFER IN THE FLOW OF SODIUM IN A COOLED TUBE
A. S. Andreev, E. D. Fedorovich, and A. V. Shchedrin *In its* Liquid Metals. Collection of Articles Jun. 1965 p 72–77 refs (See N65-31390 20-33) CFSTI: $5.00

Heat transfer was measured in a circulating liquid sodium circuit to obtain data on the influence of temperature conditions in the flow; and the local content of oxygen was monitored to determine the relative contact of oxygen in the sodium on the amount of contact resistance. The presence of contact resistance is responsible for worsening the heat transfer. The thermal contact resistance R_c as a function of the averaged temperature of the streamlined surface (degree of contamination of sodium with oxygen), and the distribution of oxygen over the section of the channel for heating and cooling sodium is graphically presented. Experimental results indicate that the reason for the appearance of R_c on the cooled surface of sodium samples from the heat exchanger is sodium oxide impurity precipitated from the liquid metal. The samples were also chemically analyzed and the data were compared with R_c measurements. It was found that R_c is approximately proportional to the relative content of oxygen. Thus it appears possible to estimate the criteria of the required purification of the metal by knowing the corresponding value for R_c. L.S.

N65-31396 Atomic Energy Commission, Washington, D. C. Div. of Technical Information.
HEAT TRANSFER DURING HEATING AND COOLING OF HEAVY METAL IN A TUBE
A. S. Andreev and D. M. Kalachev *In its* Liquid Metals. Collection of Articles Jun. 1965 p 78–81 refs (See N65-31390 20-33) CFSTI: $5.00

Heat transfer data were obtained for liquid heavy metals flowing through a tube, under a variety of heating and cooling conditions, to determine ways for increasing heat removal by liquid metals by reducing the content of impurities (primarily oxides) in the metal flow, and by creating reliable wetting of the heat exchange surface. Samples of the heat transfer agent were chemically analyzed to monitor the oxygen content in the circulation circuit. The rate of metal flow was determined calorimetrically, and the metal was continuously purified by reducing the oxides directly in the circuit (holding the oxygen content at a low level). The characteristic dependence of continuous chemical purification on heat transfer is graphically shown. Experiments were conducted until stable heat exchange was achieved. The results of experiments in the absence of oxide film on the tube wall are also graphically shown. The values of the average heat-transfer coefficient are high and agree well with the theoretical formula $Nu = 7.5 + 0.005\ Pe$. L.S.

N65-31397 Atomic Energy Commission, Washington, D. C. Div. of Technical Information.
INVESTIGATION OF LOCAL HEAT TRANSFER TO MERCURY IN A CIRCULAR TUBE IN THE PRESENCE OF A SINUSOIDAL THERMAL LOAD ALONG THE FLOW
V. I. Petrovichev *In its* Liquid Metals. Collection of Articles Jun. 1965 p 82–88 refs (See N65-31390 20-33) CFSTI: $5.00

A description is given of an experimental method and of the results of an experimental investigation of local heat transfer to a turbulent flow of mercury in a circular tube with a length to diameter ratio $l/d = 67$. The experimental data are presented in the form of the local dimensionless temperature of the wall and the local Nu_x number as a function of the Pe number. Author

N65-31398 Atomic Energy Commission, Washington, D. C. Div. of Technical Information.
MEASUREMENTS OF THE TEMPERATURE DISTRIBUTION IN THE TURBULENT FLOW OF MERCURY IN A CIRCULAR TUBE
L. S. Kokorev and V. N. Ryaposov *In its* Liquid Metals. Collection of Articles Jun. 1965 p 89–106 refs (See N65-31390 20-33) CFSTI: $5.00

The temperature distribution in a turbulent flowing stream of mercury was measured by means of longitudinal temperature probe for determining the value of the ratio of the coefficients of the turbulent transfer of heat and momentum. Schematic

diagrams of the equipment arrangement, heat exchanger, and probe are given. The temperature profile data obtained are tabulated and plotted, and compared with theoretical plots. Data from measurements of individual experiments are also graphically presented in the form of dimensionless excess temperature profiles. Empirical values for three values of the Re number are given. Comparison of values for the coefficient of turbulent transfer for mercury, ordinary, and liquid metal heat transfer agents indicate that the Prandtl number Pr has a relatively weak influence on the size of the ratio of the coefficients of turbulent transfer of heat and momentum. L.S.

N65-31399 Atomic Energy Commission, Washington, D. C. Div. of Technical Information.
EXPERIMENTAL INVESTIGATION OF HEAT TRANSFER DURING THE FLOW OF LIQUID METAL IN CHANNELS WITH ANNULAR CROSS SECTION
V. M. Borishanskii, L. L. Shneiderman, and L. S. Svetlova *In its* Liquid Metals. Collection of Articles Jun. 1965 p 107–115 refs (See N65-31390 20-33) CFSTI: $5.00

The rate of heat transfer during the flow of liquid metals through closed circuits, in channels of annular cross section with relative diameters $d_2/d_1 = 1.36$ and 1.54 was investigated. Experiments with lightweight ($Pr \cong 0.006$) and heavy ($Pr \cong 0.03$) carriers were performed. Schematic diagrams of the annular channel of the working section of the circuit, and the calorimetric setup are shown. The heat transfer coefficient was calculated with respect to the mean temperature of the heat-releasing wall and the averaging of local heat transfer. The specific heat load for the calorimeter surface was computed also. Formulas used for the calculations are given, and terms are defined. Experimental data in comparision with literature data are inconclusive, and further experiments in the presence of broad variations in Pr numbers, relative diameters, and physiochemical conditions in the flow and at the phase interface, are suggested for clarifying the problem. L.S.

N65-31400 Atomic Energy Commission, Washington, D. C. Div. of Technical Information.
MEASUREMENT OF THE MEAN COEFFICIENTS OF HEAT TRANSFER OF LIQUID METALS BY A HEAT EXCHANGER
D. I. Gremilov and D. M. Kalachev *In its* Liquid Metals. Collection of Articles Jun. 1965 p 116–123 refs (See N65-31390 20-33) CFSTI: $5.00

A method is proposed for finding the mean heat-transfer coefficients for different velocities of single-phase turbulent flow of liquid metal in tubes of a given shape, by measuring the heat transfer coefficients, and substituting the experimental data into working formulas relating the coefficient of heat transfer, the coefficient of heat transfer of the investigated heat carrier, the thermal resistance with respect to the secondary coolant, and the heat transmitting wall. L.S.

N65-31401 Atomic Energy Commission, Washington, D. C. Div. of Technical Information.
HEAT TRANSFER IN THE PRESENCE OF LONGITUDINAL FLOW IN THE INTER-TUBE SPACE OF LIQUID METAL HEAT CARRIERS.
V. M. Borishanskii and E. V. Firsova *In its* Liquid Metals. Collection of articles Jun. 1965 p 124–144 refs (See N65-31390 20-33) CFSTI: $5.00

Heat transfer in the presence of longitudinal flow was investigated in the inter-tube space of liquid metal heat carriers from two standpoints: 1) temperature fields over the calorimeter surface and in the liquid flow, with the object of calculating the local heat transfer coefficients characterizing the intensity of heat removal over different parts of the surface, and 2) mean heat transfer coefficient determination on the basis of heat-balance tests for the heat exchanger, with subsequent calculation of the mean heat transfer coefficient for the entire surface of shell-side space. The experimental setups designed for these approaches are schematically diagrammed. From the experimental data, principal qualitative laws of local heat transfer were established. L.S.

N65-31402 Atomic Energy Commission, Washington, D. C. Div. of Technical Information.
HEAT TRANSFER IN THE PRESENCE OF TRANSVERSE FLOW OF LIQUID METALS AROUND TUBE BUNDLES
V. M. Borishanskii, A. A. Andreevskii, V. B. Zhinkina, and L. L. Shneiderman *In its* Liquid Metals. Collection of Articles Jun. 1965 p 145–170 refs (See N65-31390 20-33) CFSTI: $5.00

The results of an experimental investigation of heat transfer during transverse flow of liquid metal around bundles of round tubes of different configurations are described. Distribution curves of local heat transfer over the tube perimeter are given, and recommendations for calculating mean heat transfer for the transverse flow of sodium and mercury around staggered tube bundles are presented. It was established that the mean heat transfer can vary 10% to 15% depending on the type of formula used in calculating the experimental data. L.S.

N65-31490# Massachusetts Inst. of Tech., Cambridge. Fluid Mechanics Lab.
TEMPERATURE DISCONTINUITIES AND ENERGY TRANSFER IN ONE-DIMENSIONAL RADIATION PROBLEMS
Yuan-Siang Pan Jun. 1965 32 p refs
(Contract Nonr-1841(93))
(Publ.-65-4; AD-618220)

A formulation for the temperature (or emissive power) distribution and radiative energy flux is given for a radiating grey gas layer bounded by two parallel black surfaces. The gas temperatures at the surfaces are solved exactly by using the Laplace transform. The temperature of the gas at the surface is, in general, not equal to the surface temperature. The temperature discontinuity is made up of the sum of two terms, an exponential of the optical thickness of the gas layer and an integral of an exponential of the optical thickness. An analytic solution for the energy flux is obtained by assuming an approximate temperature (or emissive power) distribution function. Results for the temperature (or emissive power) discontinuities and energy flux are presented as a function of the gas layer optical thickness. Comparisons with numerical results and other approximate calculations are made. Author

N65-31498# ARO, Inc., Arnold Air Force Station, Tenn.
COMBINED EFFECTS OF VISCOUS INTERACTION AND IDEAL SOURCE FLOW ON PRESSURE AND HEAT-TRANSFER DISTRIBUTIONS OVER HEMISPHERE CYLINDERS AT $M_\infty = 18$
R. H. Eaves, Jr. and Clark H. Lewis Arnold Eng. Develop. Center, Jul. 1965 33 p refs
(AEDC-TR-65-158; AD-467447)

The combined effects of ideal source flow and viscous interaction on the pressure and heat-transfer distributions over hemisphere-cylinders are presented, and a comparison is made with experimental data from two of the AEDC-VKF hotshot tunnels. Ideal gas characteristics solutions for the inviscid flow field over the hemisphere-cylinders were obtained

for ideal source flow fields matched to the tunnel geometry. The inviscid and viscous (laminar boundary layer) flow fields were iterated, and the resulting pressure and heat-transfer distributions were compared with the experimental data. Ideal gas analyses made at $M_\infty = 18$ predicted pressure and heat-transfer distributions over a 4-in.-diam model in the 100-in. hotshot Tunnel F, and pressure distributions for a similar model in the 50-in. hotshot Tunnel H were found in reasonably good agreement with the experimental data. Author

N65-31556*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

HEAT-TRANSFER CHARACTERISTICS OF CRYOGENIC HYDROGEN FROM 1000 TO 2500 PSIA FLOWING UPWARD IN UNIFORMLY HEATED STRAIGHT TUBES

R. C. Hendricks, R. J. Simoneau, and R. Friedman Washington, NASA, Sep. 1965 40 p

(NASA-TN-D-2977) CFSTI: HC $2.00/MF $0.50 CSCL 20M

Some heat-transfer characteristics of cryogenic hydrogen flowing vertically upward in uniformly joule-heated straight tubes were assessed over the pressure range of 1000 to 2500 psia. The fluid appeared to exhibit gas-like behavior in this regime. Heat-transfer data for the most part were predictable to ±20 percent by the Nusselt-film correlation

$$Nu_f = C Re_f^{p} Pr_f^{0.4}$$

where $C = 0.021$ and $p = 0.8$. A closer examination, however, of the data for each test section indicated that the Reynolds number exponent p can vary between 0.83 and 0.9 with the constant C changed correspondingly from 0.011 to 0.006. These correlations hold for heat fluxes up to 10 Btu per square inch per second, wall-to-bulk temperature ratios to 11, mass-flow rates to 0.4 pound mass per second, film Reynolds number from 10^5 to 4×10^6, and inside tube diameters from 0.21 to 0.438 inch; the effects of length-to-diameter ratio and Mach number were not established under all conditions. A limited amount of data taken while the largest diameter test section (0.438 in.) was in a high frequency lateral oscillation showed a significant increase in heat transfer over that predicted in the previous Nusselt-film correlation. Author

N65-31561# Lockheed Missiles and Space Co., Sunnyvale, Calif.

DETERMINATION OF THE THERMAL FLUXES IN THE NEIGHBORHOOD OF A DOUBLE CURVATURE STAGNATION POINT DURING THE FLOW OF A DISSOCIATING GAS OF ARBITRARY CHEMICAL COMPOSITION AROUND A BODY

G. A. Tirskii [1964] 15 p refs Transl. into ENGLISH from Prikl. Mekhan. i Tekhn. Fiz. (USSR), no. 1, 1965 p 45-56

Equations are formulated for a compressible, homogeneous boundary layer having variable physical properties around a stagnation point with different principal curvatures in the presence of a gas injection with the same properties as the free stream. The concept of effective diffusion coefficients in a multicomponent boundary layer is used, and the analogy between heat and mass exchange is generalized. The numerical solutions are used to obtain formulas for the thermal fluxes during the flow of a dissociating gas of arbitrary chemical composition around a body, based on the fundamental assumption that all recombination reactions occur at the wall. M.G.J.

N65-31565# Atomics International, Canoga Park, Calif.

TRANS-FUGUE-I, A DIGITAL CODE FOR TRANSIENT TWO-PHASE FLOW AND HEAT TRANSFER

R. C. Noyes, J. G. Morgan, and H. H. Cappel 25 Jul. 1965 54 p refs

(Contract AT(11-1)-GEN-8)

(NAA-SR-11008) CFSTI: $3.00

To provide a tool for analysis of postulated reactor incidents involving boiling, a transient single-channel, two-phase-flow, and heat-transfer digital code has been developed. Called "TRANS-FUGUE-I," this code is based on a homogeneous hydrodynamic model which assumes equal phase temperatures and velocities. It assumes vapor generation to be heat-transfer limited only, and calculates axial distribution of velocity, void fraction, pressure, coolant temperature, and fuel temperature. Transients simulating power excursions, loss of flow, loss of pressure and channel plugging can be studied. Calculations with the code for typical sodium-cooled fast reactor situations have revealed that in many accidents void growth is not heat-transfer-limited but rather limited by self-pressurization. For these cases, the TRANS-FUGUE-I calculations were found to overestimate the void growth rate; however, a method of approximate correction for this effect was developed. Author

N65-31574*# Princeton Univ., N. J.

THERMODYNAMICS AND HIGHER-ORDER FLUID THEORIES

D. C. Leigh Washington, NASA, Aug. 1965 36 p refs

(Grant NsG-664)

(NASA-CR-292) CFSTI: HC $2.00/MF $0.50 CSCL 20M

Four boundary value problems in unsteady simple shear flow are considered. Solutions for the second-order fluid approximation are listed, including a solution which seems to be new. For the third-order fluid approximation, solutions are obtained for the linearized versions of the various problems. The Second Law of Thermodynamics, reduced to the requirement that the rate of deformation work be non-negative, is applied to these solutions. The signs of the pertinent second-order material constant is not determined whereas the signs of the pertinent third-order constants are determined. On the other hand, the Second Law places restrictions on the allowable solutions; for some problems no solution is valid. The implications of these results are discussed. Author

N65-31601# Auburn Univ., Ala. Dept. of Mechanical Engineering.

SELECTED METHODS FOR DETERMINING THERMAL CONDUCTIVITY AND DIFFUSIVITY OF SOLID PROPELLANT Final Report

G. E. Tanger, S. C. Cheng, H. C. Kim, and G. H. Nix May 1965 44 p refs

(Contract DA-01-009-ORD-1023)

(Rept.-XII; AD-468279)

A summary of investigations pertaining to determination of thermal conductivity and thermal diffusivity of solid propellant is given. The line-source technique, a transient method, is recommended for routine determination of conductivity. Accuracy is ±5%, and the method compares favorably with steady-state methods currently in use. The method adopted for difusivity determination is discussed. A finite-difference method of computation yields the closest agreement with experiment and is recommended for future use. Accuracy of results calculated with the finite-difference technique was ±4%. Author

N65-31605# Princeton Univ., N. J. Dept. of Aerospace and Mechanical Sciences.

A CRITICAL EXAMINATION OF THE FLUID DYNAMIC PROBLEM POSED BY THE LAMINAR JET DIFFUSION FLAME

Arnold Goldburg and Cheng Sin-I Jul. 1964 47 p refs *Its* Rept.-702
(Contract AF 49(638)-1271)
(AFOSR-64-1595; AD-449691)

Boundary layer similar solutions are presented for the relevant distributions of the physical properties and species concentrations in a planar laminar jet diffusion flame. These solutions encompass a detailed consideration of the distributions of the various properties along the center line of the jet and across several transverse planes. Calculations were made for a system of oxygen and ethylene. The results are presented in graphical form. This information is used to indicate what the fluid dynamic difficulties are and to determine what factors must be considered and what approach must be taken in order to make an approximate theoretical estimate of the flame length. R.N.A.

N65-31633# General Dynamics/Fort Worth, Texas. Nuclear Aerospace Facility.
ANALYSIS OF ASTR RADIATION HEATING IN AEROSPACE STRUCTURAL MATERIALS Technical Report, 1 Oct. 1963–30 Sep. 1964
I. C. Roberts and D. A. Goodwin Feb. 1965 108 p refs
(Contract AF 29(601)-6213)
(FZK-202; WL-TR-64-152; AD-613471)

The heat generated in the material used for shielding and structure constitutes an important problem associated with the use of nuclear energy in aerospace missions. The calculation of the heat generated involves the use of computer codes based on the differential energy spectra obtained by a moments-method solution of the Boltzmann transport equation. This solution yields a modified spectrum at a specified point from a given source point after penetration of a multilayer shield. A summation of the spectra from all the source points gives the total spectrum. Integration of the spectrum over energy, with the use of the proper energy-absorption coefficients, gives the heat deposition rate in the test materials. To evaluate the calculational methods, some typical shielding and structural materials were irradiated by the Aerospace Systems Test Reactor (ASTR) at the Nuclear Aerospace Research Facility (NARF). The materials tested in this experiment were Inconel-X, aluminum, and 6% borated polyethylene. The difference between the calculated and measured data is less than 20% of the measured value for Inconel-X and aluminum but is larger for the borated polyethylene. Author

N65-31647*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
HEAT TRANSFER IN THERMAL ENTRANCE REGION WITH LAMINAR SLIP FLOW BETWEEN PARALLEL PLATES AT UNEQUAL TEMPERATURES
Robert M. Inman Washington, NASA, Sep. 1965 39 p refs (NASA-TN-D-2980) CFSTI: HC $2.00/MF $0.50 CSCL 20M

An analysis was made of the forced-convection heat-transfer characteristics for fully developed incompressible laminar flow between parallel walls with unequal temperatures under the condition that the gas density is low enough to permit a velocity slip and a temperature jump at the walls. The results apply along the entire length of the channel. The solutions contain series expansions and analytical expressions for the complete sets of eigenvalues and eigenfunctions. The results give the wall heat-flux requirements and Nusselt numbers for various values of the rarefaction parameters and dimensionless entrance-temperature parameter. The results show that, in general, the slip-flow heat-flux requirements and Nusselt numbers are lower than those for continuum flow and that they decrease with increased mean free path. The case of slip flow between parallel plates at equal temperatures is included for comparison; the length of duct necessary to obtain a fully developed Nusselt number is, for a given mean free path, the shortest for this case. Author

N65-31670 Joint Publications Research Service, Washington, D. C.
A STUDY OF THE HEAT TRANSFER COEFFICIENTS OF MODULAR ELECTRONIC EQUIPMENT
A. M. Karapetyan *In its* Izv. VUZov: Instr. Building, Vol. VIII, No. 3, 1965 p 140–148 refs (See N65-31650 20-14) CFSTI: $5.00

This paper presents a technique for the study of the heat transfer coefficient inside equipment of modular construction, describes the experimental setup, presents the basic design equations and their analysis. Author

N65-31679# General Electric Co., Philadelphia, Pa. Missile and Space Div.
NON-EQUILIBRIUM RADIATION
John L. Kulander Jun. 1965 122 p refs Revised
(R64SD41; AD-617383)

The criteria specifying the conditions for which a gas will be in a state of local thermodynamic equilibrium are discussed for both collisionally and radiatively controlled transition processes. Particular emphasis is given to the radiation field in a gas where the particle translational distribution functions are Maxwellian. A microscopic formulation of the transfer equation and solution for the source function is presented for a general n level atom where the first resonance line is optically non-thin. Specific solutions are given for a 3-level atomic model. The calculation of the radiative and collisional cross-sections and transition rates is discussed. The bound-bound and bound-free rates are calculated for the lower lying states of N I-VII assuming equilibrium distribution functions for temperatures between 10^4 and 10^{6*} K. Author

N65-31713# Bureau of Mines, Berkeley, Calif. Berkeley Thermodynamics Lab.
LOW-TEMPERATURE HEAT CAPACITIES AND ENTROPIES AT 298.15°K OF ANHYDROUS SULFATES OF COBALT, COPPER, NICKEL, AND ZINC
W. W. Weller 1965 10 p refs
(BM-RI-6669)

Heat capacity measurements of anhydrous cobalt sulfate ($CoSO_4$), copper sulfate ($CuSO_4$), nickel sulfate ($NiSO_4$), and zinc sulfate ($ZnSO_4$) were conducted over the temperature range 51° to 298° K. The results were used to evaluate the following entropies at 298.15° K (cal/deg mole): $CoSO_4$, 28.1; $CuSO_4$, 26.8; $NiSO_4$, 24.8; and $ZnSO_4$, 26.4. Entropies were combined with heats of formation to give free energies of formation. Author

N65-31723# California Univ., Berkeley. Lawrence Radiation Lab.
THERMODYNAMICS AND HIGH STRENGTH MATERIALS
Alan W. Searcy and Lies N. Finnie 10 Aug. 1964 26 p refs
(Contract W-7405-ENG-48)
(UCRL-11470; CONF-710-4)

The thermodynamic implications of Henry's law are analyzed. The use of thermodynamic equations consistent with Henry's law to evaluate and predict the variation with temperature of solubilities of solid and gaseous elements in metals is explored. The effect of a metal solute on the solubility of a nonmetal solute is discussed. The possibility of using vacuum heating to

remove hydrogen, oxygen, and nitrogen is briefly analyzed, and the possibility of removing carbon by heating in low pressures of oxygen is considered. Author

N65-31725# Brussels Univ. (Belgium).
CONTRIBUTIONS IN NON-EQUILIBRIUM STATISTICAL MECHANICS AND THERMODYNAMICS Final Technical Report
I. Prigogine 30 Jun. 1964 234 p refs
(Grant AF-EOAR-62-16)
(AFOSR-65-1059; AD-617790)

The statistical mechanics of irreversible processes is under study. Research was conducted on classical nonuniform systems; classical systems in a uniform external field; transport properties for classical systems; plasma physics; relativistic effects in statistical hydrodynamics; quantum transport theory; and thermodynamic approach to stability problems. R.W.H.

N65-31736# Atomics International, Canoga Park, Calif.
OPERATING REQUIREMENTS FOR SCTI 35 MW SODIUM HEATER IN THE EVENT OF SODIUM LEAK
R. Cygan 23 Jul. 1964 10 p
(Contract AT(11-1)-GEN-8)
(NAA-SR-10250)

Various operating conditions to dissipate the heat energy in the refractory lining of a 35 MW sodium heater during emergency shutdown are discussed. Draining the heater tubes before the brickwork has cooled leads to excessive metal temperatures. The use of a forced draft fan is recommended, until the tube temperatures in the radiant section of the heater start to decline. Complete furnace cooling to about 1600° F will take about four or five hours. Rapid heat removal by maintained sodium circulation is not recommended because it more than doubles the leak rate. Magnitude of the leak can be determined from the change in sodium level in the primary expansion tank. A large leak requires the isolation of the complete heater using the block valves. Gravity drainage from a large leak will empty the heater in about 21 minutes. G.G.

N65-31743# Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics.
BOUNDS IN MELTING PROBLEMS WITH ARBITRARY RATES OF LIQUID REMOVAL Technical Report No. 29
Ting-Shu Wu and Bruno A. Boley Apr. 1964 48 p refs
(Contract Nonr-266(20))
(CU-24-64-ONR-266(20)-CE; AD-617329)

A slab, whose material properties are dependent on both temperature and position, is insulated on one face and heated on the other according to either prescribed heat flux or temperature, so that eventually it begins to melt. After melting has started, a portion of the molten material is instantaneously removed at some prescribed rate. It is shown that the solution of this melting problem is unique, and that, under certain conditions, larger rates of heating and/or ablation result in larger rates of melting and in higher temperatures. In order to arrive at these results just stated, it is first necessary to extend the strong maximum principle for parabolic differential equations to the pertinent nonlinear case, and to prove a uniqueness theorem and a comparison theorem for the nonlinear Fourier heat-conduction equation under various boundary conditions. Author

N65-31775# General Dynamics/Convair, San Diego, Calif.
SURVEY OF THERMAL PROPERTIES OF SELECTED MATERIALS
J. Hertz and D. Knowles 15 Feb. 1965 172 p refs
(ZZL-65-008; AR-504-1-553)

A literature survey was conducted to obtain density, melting range, specific heat, thermal conductivity, and emissivity of fifteen materials commonly used at GD/A. The information will be utilized to update existing computer programs. The materials investigated included two aluminum alloys (2024 and 7075), two stainless steel alloys (301 and 321), two titanium alloys (5 A1-2.5 Sn and 6 Al-4V), copper, quartz, phenolic-fiberglass laminate, TFE Teflon, silicone rubber, polyurethane foam, polystrene foam, phenolic-fiberglass honeycomb and aluminum honeycomb. Author

N65-31794# Aerojet-General Corp., Sacramento, Calif.
INVESTIGATIONS OF THE MECHANISMS OF DECOMPOSITION, COMBUSTION, AND DETONATION OF SOLIDS Final Report, Mar. 1964–Feb. 1965
F. J. Chéselske 15 Mar. 1965 1965 241 p refs
(Contract AF 49(638)-851)
(Rept.-0372-01F; AD-458854)

This report summarizes the results of research on the mechanisms of decomposition, detonation and combustion of solids. Extensive kinetic studies have been made on (1) linear surface regression rates of solid high explosives, (2) sublimation of ammonium halides, (3) thermal decomposition of anhydrous perchloric acid, and (4) apparent flame strength measurements on NH_3 with O_2, Cl_2, NO and N_2O in the opposed-jet diffusiion flame reactor. Preliminary phenomenological studies have been carried out on the decomposition of pure or nearly pure single crystals of ammonium perchlorate. Theoretical studies were made on reactions in opposed-jet diffusion flames. New models were developed to explain extinction phenomena in solid rocket motors and a low pressure deflagration limit. Author

N65-31835# Malaker Labs., Inc., High Bridge, N. J.
KINETIC STUDY OF ROCKET EXHAUST GASES Progress Report No. 3, 1 Nov. 1960–Oct. 1961
C. Anderson, E. O'Hanlon, and R. Rossi Oct. 1961 31 p ref
(Contract DA-30-069-ORD-2918)
(CM-103-3; AD-462506)

A study of the combustion of solid propellants was undertaken to develop a procedure to evaluate the degree of combustion when various additives are added to the fuel. Preliminary experiments showed that the test procedure did not yield reproducible results. The main obstacle was the short burning time of the usual six-inch propellant strands. A study was made of alternate burning devices in an effort to use longer strands and thus obtain longer burning times. Since no suitable apparatus is available, Malaker Laboratories developed the design principles and the preliminary design of such a unit. Author

N65-31852# Atlantic Research Corp., Duarte, Calif. Missile Systems Div.
ATHENA RETRO ROCKET AND DESPIN ROCKET PLUME STUDY
Doug Fisher 15 Jun. 1964 71 p refs
(Contract AF 04(694)-220)
(Rept.-220-EN-031; AD-464821)

Because of the proximity of the control rocket motors to the payload during their functional operation, an evaluation of the potential influences of the control rockets on the payload was performed. The study considered the effect on the payload of the gaseous and particulate components of the exhaust products of the 1.0 KS 40 despin-respin subsystem and the Hercules spherical retro motor subsystem. The results of the study verify the feasibility of using the despin-respin rockets with no resultant detrimental effects on the proposed payloads.

The effects on the payload of the spherical retro rockets are shown to be negligible with stage-payload separation distances greater than 30 feet. Author

N65-31868# Aeronutronic, Newport Beach, Calif.
INVESTIGATION OF THERMODYNAMIC PROPERTIES OF ROCKET COMBUSTION PRODUCTS First Quarterly Technical Report, 1 Apr.–1 Jun. 1965
D. L. Hildenbrand, E. Murad, L. P. Theard, and F. Ju 30 Jul. 1965 11 p refs
(Contract AF 04(611)-10743)
(U-3197; AD-467590)

The heat of formation and dissociation energy of BeCl(g) were determined by mass spectrometric studies of the equilibria: Be(g) + AlCl(g) = BeCl(g) + Al(g), and for Be(g) + $BeCl_2$(g) = 2 BeCl(g). Results from measurements at electron energies two volts above threshold, and also from measurements five volts above threshold were combined with the available heats of formation. The obtained value of ΔHf_{298}[BeCl(g)] for the first reaction was 14.1 ±2.2 kcal/mole, and for the second reaction 13.0 ±2.9 kcal/mole. The obtained value for D°_{0}(BeCl) was 91 kcal, or 4.0 eV. The heat of formation of BeF was studied for the equilibrium: (Be(g) + AiF(g) = BeF(g) + Al(g), and the obtained value for D°_{0} was 134 ±2 kcal or 5.8 ±0.1 eV. Sublimation measurements with two different beryllia torsion cells gave ΔH_{298} = 76.5 and 77.1 kcal/mole. Preliminary studies of BeO vaporization with tungsten and rhenium effusion cells in the range 2200° to 2300° K found higher than calculated total pressure data for both cells. G.G.

N65-31879# Eidgenossische Technische Hochschule, Zürich (Switzerland).
MEASUREMENT OF THE THERMAL CONDUCTIVITY OF ORGANIC, ALIPHATIC LIQUIDS AND OF GASES BY A STATIONARY ABSOLUTE PROCESS [MESSUNG DER WARMELEITFAHIGKEIT VON ORGANISCHEN, ALIPHATISCHEN FLUSSIGKEITEN UND VON GASEN NACH EINEM INSTATIONAREN ABSOLUTUERFAHREN]
Wolfram Jobst (Ph.D. Thesis) Juris Verlag, 1964 58 p refs In GERMAN
(PROM.-3547)

A thin platinum wire, placed vertically into the investigated media, was used to find the absolute heat conducting values of homogeneous rows of organic, viscous fluids, and of gases. The following groups of aliphatic liquids were investigated: n-paraffins, n-alcohols, n-fatty acids, aldehydes, and ethers. The observed temperature range was:

$$-100 \leq T(^{\circ}C) \leq +200$$

It was found that the heat conductance was a linear function of temperature in all investigated organic liquids. The heat conductance ability of gaseous nitrogen was measured at 20.0° C under $0.3 \leq p(ata) \leq 4$ pressure and the results are shown in a diagram. Transl. G.G.

N65-31919# Kernforschungszenstrum, Karlsruhe (West Germany). Institut fur Angewandte Reaktorphysik.
REACTOR TEMPERATURE TRANSIENTS WITH SPATIAL VARIABLES. PART I: RADIAL ANALYSIS
L. Caldarola and E. G. Schlechtendahl Brussels, EURATOM, 1965 60 p refs
(Contract EURATOM-009-63-1 RAAD)
(EUR-2403.e) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 70 Belg. Fr.

The equation, which describes the heat balance equation in a cylindrical fuel element under unstationary conditions, has been solved by using the method of the Laplace transformation. A parametric study of the solution has been developed and it has been found that the temperature transients are dependent on two parameters: the radial time scale,

$$t_r = \frac{\text{fuel density} \times \text{fuel specific heat capacity}}{\text{fuel thermal conductivity}} \text{(fuel radius)}$$

and the dimensionless parameter

$$\gamma = \frac{\text{fuel thermal conductivity}}{2 \times \text{heat transfer coefficient} \times \text{fuel radius}}$$

The transfer functions have been antitransformed by using two different methods of approximation: one expressed in sums of exponentials and the other with the error function. Numerical examples are included with reference to SEFOR reactor and to power reactors. Author

N65-31959# General Electric Co., Phialdelphia, Pa. Missile and Space Div.
MEASUREMENTS OF TURBULENT HEAT TRANSFER AND SKIN FRICTION REDUCTION ON A POROUS CONE WITH AIR INJECTION AT HIGH MACH NUMBERS
R. P. Fogaroli 22 Dec. 1964 29 p refs
(Contract AF 04(694)-486)
(Doc.-64SD5291; AD-355894) (Declassified)

Measurements of turbulent heat transfer and skin friction reduction on a large slender porous cone were obtained at cone Mach numbers of 5.3 and 8.1 using air as the injected coolant. The test model had a 7.5° half-angle and a 12-inch base diameter. The test extended the available published data to very high mass injection rates and confirmed that the heat transfer reduction due to mass injection is relatively independent of the local edge Mach number. The skin friction results displayed a pronounced dependency on Mach number as established by previous data, indicating that Reynolds analogy with mass transfer is invalid at the high Mach numbers and injection rates encountered by high W/C_DA ablating vehicles during re-entry. Test data also indicated a significant induced pressure effect on the aerodynamic drag force due to large mass injection rates. Author

N65-31973# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.
TURBULENT MIXING OF AXISYMMETRIC JETS OF PARTIALLY DISSOCIATED NITROGEN WITH AMBIENT AIR Final Report, Mar. 1964–Jun. 1965
T. J. O'Connor, E. H. Comfort, and L. A. Cass 15 Jul. 1965 119 p refs
(Contract Nonr-3307(00))
(RAD-TR-65-18; AD-617732)

A research program was conducted to determine radial and axial variations in fluid properties, i.e., velocity, density, enthalpy, etc., in compressible free jets of dissociated gases produced by electric-arc plasma generators. Experimental investigations were confined to the near flowfield of the jets, since 90 percent of change in jet fluid properties, from their initial values at the arc nozzle-exit plane to the properties of the ambient fluid, was accomplished within 40 nozzle radii from the jet origin. Heat-transfer rates from these jets, when impinging upon a flat surface perpendicular to the jet axis, were determined experimentally. Correlation of this data could then be accomplished by means of a relationship similar to those for stagnation-point heat transfer to blunt bodies in a uniform stream when local jet properties were employed. Author

N65-32001*# National Bureau of Standards, Washington, D. C.
THERMODYNAMIC AND RELATED PROPERTIES OF PARAHYDROGEN FROM THE TRIPLE POINT TO 100° K AT PRESSURES TO 340 ATMOSPHERES
H. M. Roder, L. A. Weber, and R. D. Goodwin 10 Aug. 1965 116 p refs
(NASA Order R-45)
(NASA-CR-644443; NBS-Monograph-94) CFSTI: HC $4.00/MF $0.75 CSCL 20M

Experimental programs on parahydrogen at this laboratory have provided pressure-density-temperature relations and heat capacities at temperatures from 15 to 100° K and at pressures from 2 to 350 atm. The two types of data have been correlated to yield a consistent set of functions. The properties tabulated for selected isobars are temperature, volume or pressure, the isotherm derivative $(\delta P/\delta_\rho)_T$, the isochore derivative $(\delta P/\delta T)_\rho$, internal energy, enthalpy, entropy, the specific heats at constant volume and at constant pressure, and the velocity of sound. Also presented are the derived Joule-Thomson inversion curve and some comparisons with normal hydrogen near 100° K. Author

N65-32046*# National Bureau of Standards, Boulder, Colo. Cryogenics Div.
CRYOGENIC PROPELLANT VENTING UNDER LOW PRESSURE CONDITIONS Final Report
M. C. Jones, T. T. Nagamoto, J. A. Brennan, Patricia J. Giarratano, and R. V. Smith 17 Jun. 1965 46 p refs
(NASA Order H-42001)
(NASA-CR-64542; NBS-8819) CFSTI: HC $2.00/MF $0.50 CSCL 20M

Heat transfer coefficients have been measured to two-phase, single component, solid-vapor mixtures flowing through a short vertical tube. The two-phase mixtures were produced by venting liquids parahydrogen and nitrogen to pressures of from 4 to 17.5 mm Hg. At sufficiently high heat flux the mixtures have been found to flow freely through the tube with no tendency for solid to build up in the tube. Author

N65-32051# Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.
EXPERIMENTAL STUDY OF HEAT CONDUCTION THROUGH RAREFIED GASES CONTAINED BETWEEN CONCENTRIC CYLINDERS
Alexander Dybbs and George S. Springer Jun. 1965 27 p refs
(Contract Nonr-1841(93))
(Publ.-65-3; AD-618219)

Experiments were performed to measure heat conduction through rarefied gases at rest contained between two concentric cylinders. The test gases used were helium, neon and argon. The pressure was varied over a range that included free molecule, transition, and temperature jump conditions. The experimentally obtained heat conduction data were used to evaluate the results of the moment method proposed by Lees and Liu. Agreement between this method and the data was found to be within ±2.5% over the entire Knudsen number range covered in the experiments ($0.02 < Kn < 50$), assuming that the thermal accommodation coefficient at the inner cylinder remained constant over this range at its free molecule value. A comparison was also made between the data and the results of the temperature jump approximation, indicating that the heat conduction can be calculated by the temperature jump approximation within about 1% at Knudsen numbers less than ~0.02. Author

N65-32055# Naval Research Lab., Washington, D. C. Fuels Branch.
FLAMMABILITY PROPERTIES OF HYDROCARBON FUELS. PART I: INTERRELATIONS OF FLAMMABILITY PROPERTIES OF n-ALKANES IN AIR
W. A. Affens 25 May 1965 17 p
(NRL-6270; AD-616985)

By a systematic study of literature data, mathematical equations have been derived which describe the interrelationships of flammability and other related properties of the n-alkanes. The properties which have been correlated are: lower and upper flammability limits, flash point, vapor pressure (at the flash point), flammability index ("explosiveness"), boiling point, stoichiometric concentration, heat of combustion, molecular weight, and carbon number. Good agreement was found between average literature data and values calculated by the derived equations. From a given flammability property, by use of the derived equations, it is possible to predict the other properties, as well as the relative magnitudes of changes in these properties as a result of a change in the given property. Author

N65-32120*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ANALYTICAL DETERMINATION OF THE EFFECTIVE EMITTANCE OF AN INSULATED LOUVER SYSTEM
Stanford Ollendorf [1965] 18 p refs Presented at the Thermionics Session of AIAA Aerospace Sci. Meeting, New York, 25–27 Jan. 1965
(NASA-TM-X-54804) CFSTI: HC $1.00/MF $0.50 CSCL 20M

Using the radiosity method, the effective emittance of an insulated louver system was determined under the following boundary conditions: (1) louvers are considered adiabatic with respect to heat transfer across the blade, (2) uniform temperatures exist along louver surfaces, (3) conduction losses from louver blades are negligible, and (4) when specular surfaces are considered, they reflect specularly but emit diffusely. Two types of surface characteristics are considered, an all diffuse system and a mixed specular and diffuse system. Analytical results are compared with experimental measurements of effective emittance for both types of surface coatings. The analysis is extended to include solar influx on one louver surface for the all diffuse system. It is concluded that: (1) specular coatings applied to the inside surface of the louver will improve the effective emittance of the system, (2) adiabatic louvers act similarly to highly polished uninsulated louvers, and (3) the effectiveness of the louver system is decreased with solar influx on the shutter surfaces. S.C.W.

N65-32124*# National Bureau of Standards, Washington, D.C.
NEW METHOD FOR COOLING PHOTOCONDUCTIVE DETECTORS
Stanley Abramowitz, A. M. Bass, and A. E. Ledford, Jr. 15 Sep. 1964 10 p refs Submitted for Publication
(NASA- Order R-64)
(NASA-CR-59370; NBS-8554) CSCL 20M

An optical system is reported which uses an ellipsoidal mirror in a vacuum chamber to focus a demagnified image of the exit slit onto a photoconductive detector mounted on a rod in contact with liquid nitrogen. The ellipsoid is used on-axis and has a demagnification ratio of about six. A copper rod is used to support the detector which is mounted with silver conducting paint on the end of the rod. The ellipsoid is mounted within the dewar vacuum space. The rate of temperature drop of the detector after addition of refrigerant may be followed by measuring the increase of its resistance. In this system about 10 to 15 minutes are required to cool the the detector to liquid nitrogen temperature. The system is separated from the monochromator

by a suitable window. A calcium window may be used for the 1 to 10 micron region. A 2-inch oil diffusion pump is adequate for evacuation of the ellipsoid-detector compartment as well as the monochromator. A pressure of 10^{-5} mm Hg is readily obtained and a single filling of the dewar will last for more than 24 hours. E.E.B.

N65-32129# General Applied Science Labs., Inc., Westbury, N. Y.

HEAT TRANSFER DUE TO COMBUSTION ON A FLAT PLATE IN SUPERSONIC FLOW

W. Chinitz and L. Spadaccini Dec. 1964 59 p refs

(Contract DA-30-069-AMC-216(Z); ARPA Order 460)

(GASL-TR-486; AD-461650)

A theoretical and experimental investigation was undertaken of heat transfer effects at the surface of a flat plate on which combustion is occurring in a supersonic air stream. A simplified theoretical model is developed which leads to expressions for the heat transfer coefficient and heat transfer rate at the surface. The experimental technique used to obtain heat transfer parameters is described. The experimental tests were conducted at Mach number 3.1 using the pyrophoric fuel triethylaluminum. A comparison between the theoretical and experimental results indicates that the former yields order-of-magnitude estimates of the heat transfer coefficient and rate which are satisfactory for purposes of engineering design. The theory is then used to obtain estimates of heat transfer parameters at the surface of a cone-shaped interceptor executing a coast trajectory. The results are shown to be well correlated by an empirical expression similar to that encountered in the literature for turbulent non-reacting flow over flat plates having both constant and variable surface temperatures. Author

N65-32159*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EXPERIMENTAL INVESTIGATION OF A CHARRING ABLATIVE MATERIAL EXPOSED TO COMBINED CONVECTIVE AND RADIATIVE HEATING IN OXIDIZING AND NONOXIDIZING ENVIRONMENTS

John H. Lundell, Roy M. Wakefield, and Jerold W. Jones [1964] 25 p refs

(NASA-TM-X-54797) CFSTI: HC $1.00/MF $0.50 CSCL 20M

The effects of the magnitude and relative proportions of combined convective and radiative heating on the effectiveness of a charring material in prcviding protection against atmospheric entry heating were evaluated experimentally. Tests were conducted on phenolic nylon to study the interactions betweeen the material ablation products and the external heating environment; the tests were performed in a vacuum with radiative heating only, and in air and nitrogen streams with convective heating only, and with combined convective and radiative heating. In addition to the experimental results, a method for predicting the behavior of the charring material under other conditions is presented. J.M.D.

N65-32176*# National Aeronautics and Space Administration, Washington, D. C.

LAMINAR HEAT EXCHANGE IN THE INLET SECTION OF A RECTANGULAR CHANNEL [LAMIVARNYY TEPLOOBMEN V NACHAL'NOM UCHASTKE PRYAMOUGOL'NOGO KANALA]

I. N. Sadikov Aug. 1965 13 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (USSR), v. 8, no. 4, 1965 p 423–429

(NASA-TT-F-9548) CFSTI: HC $1.00/MF $0.50 CSCL 20M

Investigation of heat transfer in the inlet section of a rectangular channel with a laminar flow of incompressible fluid passing through the channel and a uniform or nonuniform temperature field arising at the inlet. Formulas are presented for the distribution of temperatures and Nusselt numbers along a side of a channel cross section. Author

N65-32177*# National Aeronautics and Space Administration, Washington, D. C.

HEAT CONDUCTIVITY OF TUNGSTEN AT HIGH TEMPERATURES [TEPLOPROVODNOST' VOL'FRAMA PRI VYSOKIKH TEMPERATURAKH]

Yu. N. Simonova and L. P. Filippov Sep. 1965 6 p refs Transl. into ENGLISH from Zh. Prik. Mekhan. i Techn. Fiz. (Moscow), no. 1, 1965 p 111–112

(NASA-TT-F-9553) CFSTI: HC $1.00/MF $0.50 CSCL 20M

Description of an equipment and procedure developed for measuring the heat conductivity of tungsten in the temperature range from 1500° to 3000° K. Heat conductivity is measured by determining the temperature distribution along a wire or strip of foil, heated by a current, in the region where the distribution is exponential. The results obtained for the heat conductivity of tungsten are used to determine the temperature dependence of the Lorentz number. Author

N65-32179*# National Aeronautics and Space Administration, Washington, D. C.

THE THERMODYNAMICAL THEORY OF THE RELAXATION PHENOMENA AND ITS CONNECTION WITH THE THEORY OF AFTER-EFFECTS

J. Meixner Aug. 1965 49 p refs Transl. into ENGLISH from Kolloid-Z. (Darmstadt), v. 134, no. 1, 1953 p 3–20

(NASA-TT-F-8763) CFSTI: HC $2.00/MF $0.50 CSCL 20M

A clarification is given for the thermodynamic theory of the relaxation phenomena for one internal mechanism, as well as for a finite and infinite number of such mechanisms. A series of general laws is indicated, and the dynamic equations of state that come with the elimination of the internal parameters are discussed. A direct bridge leading to the after-effect theory of the relaxation phenomena is shown, and it can be seen precisely where the equivalence of the two theories ends. A generalization of the thermodynamics of irreversible processes that is equivalent to the formalism of the theory of after-effects in a more comprehensive area is considered. An example complements the dielectric relaxation and the connection between the thermodynamic relaxation theory of a system having an infinite number of internal transformations and its linearized basic kinetic equation. The deviations from the thermodynamic equilibrium are sufficiently small so that the thermodynamics of the irreversible processes are applicable, and the superposition principle is valid. Only homogeneous systems and their reaction to outside effects are considered. C.T.C.

N65-32204# Library of Congress, Washington, D. C. Aerospace Technology Div.

AERODYNAMIC CALCULATION OF A GAS FLAME IN MAGNETOHYDRODYNAMICS [K AERODINAMICHESKOMU RASCHETU GAZONOGO FAKELA V MAGNITNOY GIDRODINAMIKE] Translations of Soviet-Bloc Scientific and Technical Literature

L. P. Yarin 28 Jul. 1965 18 p refs Transl. into ENGLISH from Teplofiz. Vysokikh Temperatur (USSR), v. 3, no. 2, 1965 p 285–293

(ATD-T-65-58; AD-618512)

An approximate method is presented for calculating diffusional combustion of gas in a plane-parallel boundary layer

in a magnetic field. The effect of the magnetic field on the aerodynamics of the gas flame is examined. Author

N65-32207# Naval Postgraduate School, Monterey, Calif.
LAMINAR CONVECTIVE HEAT TRANSFER IN THE ENTRANCE REGION BETWEEN PARALLEL FLAT PLATES
D. D. Lundberg and J. A. Miller Jun. 1965 68 p refs
(TR-54; AD-619031)

Heat transfer rates for laminar, convective heat transfer in the entrance region between parallel plates were investigated. The hydrodynamic solution due to Bodia [2] was used in the solution of the energy equation in finite difference form on a digital computer. The thermal boundary conditions include: constant heat input, constant wall temperature, one wall constant temperature and one wall insulated, and constant but different wall temperatures on the upper and lower walls. The approximate integral methods of Siegel and Sparrow [5], [7] are shown to produce results that are in close agreement with the solutions in the present analysis for the constant heat input and constant wall temperature cases. The scope of the finite difference solution is limited to a narrow range of Prandtl numbers near unity, due to the small grid sizes required for convergence. Author

N65-32208# Oklahoma Univ., Norman. School of Aerospace and Mechanical Engineering.
EXPERIMENTAL DETERMINATION OF THERMAL RADIATION SCATTERING BY SMALL PARTICLES Interim Technical Documentary Report, Feb. 1964–Mar. 1965
T. J. Love and J. F. Beattie Wright-Patterson AFB, Ohio, ARL, Jun. 1965 131 p refs
(Contract AF 33(657)-8859)
(ARL-65-110; AD-619056)

This report describes the results of a study of the extinction and scattering of thermal radiation by optically thin clouds of small particles. The mass extinction coefficient, the angular distribution of scattered radiation and the ratio of scattering to extinction is reported for particles of aluminum, carbon, glass, iron and silica. The particles have average sizes of a few microns. Measurements are made for wave length ranges from 0.7 microns to 15 microns. Author

N65-32247# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
HEAT TRANSFER IN CYLINDRICAL PIPES WITH TURBULENT FLOW AND ARBITRARY WALL FLUX AND TEMPERATURE DISTRIBUTIONS
John W. Goresh May 1965 58 p refs
(ARL-65-84; AD-618514)

The problem considered in this paper is that of finding the heat losses from a turbulent gas flowing through a pipe due to free and forced convection, conduction through the solid insulation and external wall radiation. Furthermore, along the inner wall, neither the heat flux nor the temperature variation is known in advance, but are determined by the losses from the outer wall. The analytical procedure used here is analogous to that first used by Latzko (1) and later modified by Fettis (7) for a constant wall temperature, where eigenfunctions of an approximate equation are first obtained and these are then used to obtain the solution to the actual heat equation. The numerical solution for the case $\alpha = 0.7$ is presented in the form of graphs of axial temperature distribution along the pipe as well as radial temperature profiles within the gas stream. The case where the heat transfer parameter $\alpha = 0.7$ is used corresponds to the specific dimensions and thermal properties of the stagnation chamber insulation in the ARL 30-inch hypersonic wind tunnel. Author

N65-32253*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SIZE AND DURATION OF FIREBALLS FROM PROPELLANT EXPLOSIONS
J. B. Gayle and J. W. Bransford 4 Aug. 1965 21 p
(NASA-TM-X-53314) CFSTI: HC $1.00/MF $0.50 CSCL 20M

Data from tests and vehicle incidents have been compiled and analyzed with respect to fireball diameters and durations. Both variables were found to be dependent on the cube root of the weight of the combined propellants and independent of the particular propellant combination. Fireball diameters also appear to be roughly dependent on the cube root of the ambient pressures. Author

N65-32257*# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
HEAT TRANSFER TO A GAS CONTAINING A CLOUD OF PARTICLES Semiannual Status Report No. 6
J. Andrew Mc Alister, Edward Y. H. Keng, and Clyde Orr, Jr. 30 Jul. 1965 39 p
(Grant NsG-273-62)
(NASA-CR-54441) CFSTI: HC $2.00/MF $0.50 CSCL 20M

The basic radiation equations were solved to describe the radiant heat transfer from a black, cylindrical enclosure uniformly radiating to a black, evenly dispersed particle cloud contained within. Back thermal radiation and radiation scattering were considered negligible. The solution was presented graphically in generalized form with all variables being dimensionless quantities, and comparisons with experimental data were shown. Equations were also presented for calculating the radiation absorbed by a particle cloud within unheated segments of the enclosure adjacent to the radiating element. A brief description of particle deagglomeration and cloud transmissivity studies was included. Author

N65-32269*# National Aeronautics and Space Administration, Washington, D. C.
STATISTICAL THEORY OF THE CRITICAL POINT [K STATISTICHESKOY TEORII KRITICHESKOY TOCHKI]
E. A. Zhil'kov Aug. 1965 14 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Fiz. (Tomsk), no. 4, 1964 p 54–60
(NASA-TT-F-9503) CFSTI: HC $1.00/MF $0.50 CSCL 20M

A statistical theory of the critical point is presented in this work. The theory is applied to an examination of phase changes in other systems. Author

N65-32313# Oak Ridge National Lab., Tenn.
THE THERMAL CONDUCTIVITY OF INCONEL 702
J. P. Moore and W. P. Murray [1964] 8 p refs
(Contract W-7405-ENG-26)
(CONF-764-10)

The thermal conductivity of Inconel 702 was measured in the radial heat flow apparatus in the range 50 to 930° C. Although the thermal conductivity of Inconel 702 increases nearly linearly with temperature, the alloy is subject to at least two complex reactions, age hardening and "K-state" formation, which affect the thermal conductivity. All measurements reported-to-date in the above temperature range agree to within ±2%, and those for the alloy in the same structural state agree to within ±1%. The thermal conductivity of the solution-annealed alloy was approximately 2% lower than that of the aged alloy. We are continuing to measure the thermal conductivity, as well as other properties, to study the effect of condition on the electronic and phonon contributions. Author

N65-32314# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.
TWO PHASE PRESSURE LOSSES. 1: PRESSURE LOSSES ACROSS LARGE EXPANSIONS AND CONTRACTIONS. 2. PRESSURE DROP WITH HEAT ADDITION. 3. GENERAL CONCLUSIONS Final Report
E. Janssen and J. A. Kervinen Jul. 1964 37 p refs
(Contract AT(04-3)-189)
(GEAP-4634) CFSTI: $3.00

Two-phase pressure change was measured across expansions from 2-inch to 3-1/2-inch, 4-1/2-inch, and 5-1/2-inch pipes and across contractions from 3-1/2-inch, 4-1/2-inch, and 5-1/2-inch to 2-inch pipes. The tests were with steam-water at 600 to 1400 psia flows after the expansions from 0.125×10^6 to 0.75×10^6 lb/h-ft^2 and qualities from 3 to 20%. Calculated values of pressure recovery past the expansions were compared with measured values, both single and two-phase runs; most calculated points were within 25% of measured. Also, two-phase pressure drop was measured along an internally-heated annular geometry in vertical flow. Tests were with steam-water at 600 to 1400 psia, flows from 0.5×10^6 to 1.7×10^6 lb/h-ft^2, heat fluxes from 0.55×10^6 to 0.8×10^6 Btu/h-ft^2, and exit qualities from 2 to 20%. Pressure drop increased as quality increased, except at the lowest flow values. Further, the effect of heat flux on pressure drop was less than the scatter in the data. Calculated and measured pressure drop agreed to within ±10% at all three flows. It was found that a model was useful both for predicting pressure recovery and pressure loss provided the flow was fully developed. E.E.B.

N65-32341# Case Inst. of Tech., Cleveland, Ohio.
LOW TEMPERATURE THERMAL EXPANSION COEFFICIENT OF LiF: SOLID STATE PHYSICS PROGRAM Technical Report No. 35
Richard Miles (Thesis) Jun. 1964 19 p refs
(Contract AT(11-1)-623)
(COO-623-103)

The linear thermal expansion coefficient, α, of LiF was measured by an x-ray technique from 60° K to 290° K. The Gruneisen parameter γ was calculated and analyzed in terms of the quasi-harmonic approximation. A low temperature value for γ was obtained from the pressure variation of the elastic constants by means of a numerical integration machine calculation, and it agrees favorably with the recent 14° K of γ as calculated from White's extremely low temperature thermal expansion data. Author

N65-32384# Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics.
THE SOLUTION OF A CLASS OF TWO-DIMENSIONAL MELTING AND SOLIDIFICATION PROBLEMS Technical Report No. 25
David L. Sikarskie and Bruno A. Boley May 1964 75 p refs
(Contract Nonr-266(20))
(CU-25-64-ONR-266(20)-CE; AD-617330)

Two-dimensional melting and solidification problems are divided into three convenient classes and a general method of solution for one of these is presented. The method utilizes the concept of a fictitious body of constant geometry, in which is embedded the real body (whose dimensions are changing due to the change in phase); the fictitious body is acted upon by a fictitious heat flux or (in some problems) a fictitious initial temperature distribution. The problem thus formulated in terms of these unknown fictitious quantities results in a set of integro-differential equations to be solved simultaneously, either numerically or in series form. Two problems are considered in detail. In the first problem the melting of a finite, insulated slab with the melt immediately removed is formulated and an example for a semi-infinite, insulated strip is given. In the second problem the solidification of a finite, insulated slab with zero superheat is formulated and an example for a specific cooling history is given. In both problems two-dimensional effects are introduced by spatial variations of heating or cooling conditions, and short-time series solutions are developed. Author

N65-32385# Sandia Corp., Albuquerque, N. Mex.
COMBUSTION OF ZIRCONIUM DROPLETS IGNITED BY FLASH HEATING
L. S. Nelson 30 Aug. 1964 17 p refs Presented at the 1964 Fall Meeting, Western States Sect., The Combust. Inst., Salt Lake City, 26–27 Oct. 1964
(Contract AT(29-1)-789)
(SC-DC-64-1559; CONF-815-1)

The combustion and explosion of zirconium droplets in air and in oxygen-argon mixtures was studied using a flash-heating technique which involved the preparation and ignition of droplets with the intense thermal emission of a light pulse from a capacitor discharge lamp. Several new features involved in the combustion of zirconium are described. These include showing that nitrogen is an active participant in the process when burning occurs in air, and that the explosions occur as a result of cooling and partial solidification of the droplets rather than of a steadily increasing temperature. A mechanism is proposed to explain the explosions based on the release of a permanent gas into the still-molten interior as the exterior of the droplet begins to solidify. S.C.W.

N65-32386# Sandia Corp., Livermore, Calif.
A COMPUTER PROGRAM FOR PREDICTING AERODYNAMIC HEATING ON SHARP CONES
Alec R. Willis Nov. 1964 15 p refs
(Contract AT(29-1)-789)
(SCL-TM-64-87)

Equations describing the aerodynamic heating on sharp cones and correlation functions for the properties of air are presented. The equations have been programmed for solution on the IBM 1620 digital computer. The program is designed to calculate supersonic aerodynamic heating rates at several stations on the cone surface for a specified trajectory. Author

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N65-31360# Space Technology Labs., Inc., Redondo Beach, Calif.
SELECTIONS FROM THE TRW SPACE TECHNOLOGY LABORATORIES LECTURE SERIES, VOLUME TWO
Thomas L. Branigan, ed. 1965 70 p refs

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1. THE THEORY AND APPLICATION OF MASERS AND LASERS C. H. Townes (Mass. Inst. of Tech.) p 4–13 (See N65-31361 20-16)

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3. THE EFFECTS OF HIGH-ALTITUDE EXPLOSIONS W. N. Hess (NASA, Goddard Space Flight Center) p 22–34 refs (See N65-31363 20-29)

4. THE ABUNDANCE OF THE ELEMENTS H. C. Uray (Calif. Univ.) p 35–46 refs (See N65-31364 20-06)

5. THEORETICAL ASPECTS OF THE SPACE RELATIVITY-GYROSCOPE EXPERIMENT L. I. Schiff (Stanford Univ.) p 47–50 refs (See N65-31365 20-23)

6. ENERGETIC SOLAR PARTICLES K. A. Anderson (Calif. Univ.) p 51–60 refs (See N65-31366 20-29)

7. THE ORIGIN OF PLANETARY ATMOSPHERES A. G. W. Cameron (NASA, Goddard Inst. for Space Studies) p 61–70 ref (See N65-31367 20-30)

N65-31425# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

WAYS OF FURTHER IMPROVEMENT OF ORGANIZATION AND PLANNING OF AVIATION PRODUCTION Collection of Articles

I. B. Kuksina, ed. 9 Feb. 1965 191 p refs Transl. into ENGLISH from "Puti Dal'neyshego Sovershenstvovaniya Organizatsii i Planirovaniya Aviatsionnogo Proizvodstva" Moscow, Oborongiz, 1963 p 1–176
(FTD-64-246; AD-614628)

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3. METHODS OF DISTRIBUTION OF OUTPUT OF FINISHED PRODUCTS BY TEN-DAY PERIODS AND MONTHS OF PLAN PERIOD V. I. Tikhomirov p 50–56 (See N65-31428 20-34)

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6. TECHNOLOGICAL EQUIPMENT OF PRODUCTION OF AIRCRAFT ENGINES AND METHOD OF DETERMINATION OF ITS OPTIMUM LEVEL M. G. Chernyy p 126–168 refs (See N65-31431 20-34)

7. METHODS OF CALCULATION OF ECONOMIC EFFECTIVENESS OF SPECIALIZATION OF AIRCRAFT BUILDING PRODUCTION V. I. Tikhomirov p 169–179 refs (See N65-31432 20-34)

8. CERTAIN METHODS OF DETERMINATION OF PRIME COST RADIO-ELECTRONIC EQUIPMENT S. V. Moiseyev p 180–208 refs (See N65-31433 20-34)

9. METHOD OF ENLARGED CALCULATION OF TECHNICO-ECONOMIC EFFECTIVENESS OF EQUIPMENT OF TECHNOLOGICAL PROCESSES M. P. Veselov p 209–216 refs (See N65-31434 20-34)

N65-31426 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CERTAIN QUESTIONS OF ORGANIZATION OF PRODUCTION IN AUTOMATIC SECTIONS OF MECHANICAL TREATMENT

I. B. Kuksin *In its* Ways of Further Improvement of Organ. and Planning of Aviation Production 9 Feb. 1965 p 4–27 refs (See N65-31425 20-34)

General questions of mechanization and automation of production are considered. Technical preparation for production in automation of industrial processes, standardization of engineering processes, labor organization and wage standardization, technical servicing, and quality control are discussed. E.W.

N65-31427 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EXPERIENCE OF DESIGNING OF GROUP TREATMENT OF PARTS IN MECHANICAL WORKSHOPS OF AIRCRAFT BUILDING FACTORIES

F. I. Bogomolova *In its* Ways of Further Improvement of Organ. and Planning of Aviation Production 9 Feb. 1965 p 28–49 refs (See N65-31425 20-34)

Group treatment of parts in small-lot production yields economic benefits and increased production. The technique is especially applicable to machine workshops. Classification of parts for group treatment, improvement of technological processes during group treatment of parts, industrial organization, and methods for calculating economic advantages of group processing are considered. E.W.

N65-31428 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

METHODS OF DISTRIBUTION OF OUTPUT OF FINISHED PRODUCTS BY TEN-DAY PERIODS AND MONTHS OF PLAN PERIOD

V. I. Tikhomirov *In its* Ways of Further Improvement of Organ. and Planning of Aviation Production, 9 Feb. 1965 p 50–56 (See N65-31425 20-34)

Methods are outlined for regulating production processes so that the quantity of finished products meets the scheduled requirements and so that the factory operation is reasonably uniform. Plans are given for increasing output and for diminishing output, as for a discontinued item. It is concluded that output must be planned in ten day or monthly periods in order to fulfill quantity commitments and to preserve the rhythm of the production process. E.W.

N65-31429 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ESTABLISHMENT OF NOMENCLATURE OF INSTRUMENTS AND RADIO PARTS OF ASSEMBLIES OF GENERAL PURPOSE APPLIED IN AVIATION FOR SPECIALIZATION OF THEIR PRODUCTION

S. V. Moiseyev *In its* Ways of Further Improvement of Organ. and Planning of Aviation Production 9 Feb. 1965 p 57–78 refs (See N65-31425 20-34)

A method for determining nomenclature of articles to be produced in specialized factories is presented. In addition, techniques are given for calculating the cost of manufacturing radio parts. The methods were checked experimentally, and on the basis of the results norms for calculating the cost of an altimeter were developed. E.W.

N65-31430 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN QUESTIONS OF DEVELOPMENT OF TECHNICAL STANDARDIZATION IN MACHINE BUILDING
Ye. I. Sherman *In its* Ways of Further Improvement of Organ. and Planning of Aviation Production 9 Feb. 1965 p 79–125 (See N65-31425 20-34)

Problems of technical standardization under conditions of automatic production, methods for determining labor consumption of manufacturing process, and techniques for studying labor and technological processes and expenditures of time are discussed. E.W.

N65-31431 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TECHNOLOGICAL EQUIPMENT OF PRODUCTION OF AIRCRAFT ENGINES AND METHOD OF DETERMINATION OF ITS OPTIMUM LEVELS
M. G. Chernyy *In its* Ways of Further Improvement of Organ. and Planning of Aviation Production 9 Feb. 1965 p 126–168 refs (See N65-31425 20-34)

The problem of technological equipment for production of aircraft and its influence on prime cost and labor consumption of manufacturing process is considered. Existing methods for determining level of equipment supply are analyzed, and a new method is given for calculating the optimum level. E.W.

N65-31432 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHODS OF CALCULATION OF ECONOMIC EFFECTIVENESS OF SPECIALIZATION OF AIRCRAFT BUILDING PRODUCTION
V. I. Tikhomirov *In its* Ways of Further Improvement of Organ. and planning of Aviation Production 9 Feb. 1965 p 169–179 refs (See N65-31425 20-34)

Formulas are derived for calculating the economic advantages of specialization in aircraft production. Each method is analyzed, and it is shown that none of the techniques are acceptable for calculating the economic effectiveness of one or another form of specialization in industry. E.W.

N65-31433 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN METHODS OF DETERMINATION OF PRIME COST RADIO-ELECTRONIC EQUIPMENT
S. V. Moiseyev *In its* Ways of Further Improvement of Organ. and Planning of Aviation Production 9 Feb. 1965 p 180–208 refs (See N65-31425 20-34)

The problem of creating norms for specific expenditures in experimental aircraft production is discussed. Methods are indicated for improving norms for calculation of prime cost, and for increasing their stability and universality. E.W.

N65-31434 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF ENLARGED CALCULATION OF TECHNICO-ECONOMIC EFFECTIVENESS OF EQUIPMENT OF TECHNOLOGICAL PROCESSES
M. P. Veselov *In its* Ways of Further Improvement of Organ. and Planning of Aviation Production 9 Feb. 1965 p 209–216 refs (See N65-31425 20-34)

One method for calculating the technico-economic effectiveness of industrial processes is analyzed. Model nomographs and examples of their use are presented. It is concluded, however, that this technique cannot be used to calculate the prime cost of any given production procedure. E.W.

N65-31478# Office of Naval Research, Washington, D. C.
THE YEAR IN NAVY SCIENTIFIC AND TECHNICAL INFORMATION
Charles de Vore [1965] 10 p refs
(AD-617315)

Highlights in scientific and technical information preparation, dissemination, storage and retrieval within the Navy are reviewed. The focal point for this activity is the Office of Naval Research (ONR) which has the responsibility for acquisition and dissemination of world-wide scientific information to bureaus and activities of the Department of the Navy. Also, the mechanization of some of the library procedures with the Naval Research Laboratory is discussed. Further, the pioneering in microfiche by th Naval Weapons Laboratory is reviewed. E.E.B.

N65-31483# Naval Research Lab., Washington, D. C.
REPORT OF NRL PROGRESS
May 1965 58 p refs
(PB-167330)

CONTENTS:

1. CONTAMINANTS IN THE SEALAB I ATMOSPHERE R. A. Saunders p 1–7 refs (See N65-31484 20-05)
2. NRL CENTRALIZED ELECTRONIC CONTROL PACKAGING D. A. Venn, E. Toth, and J. S. West p 8–19 refs (See N65-31485 20-09)
3. SCIENTIFIC PROGRAM p 20–55 refs

N65-31589# Physics International Co., San Leandro, Calif.
EXPLOSIVE GAS GUN Fourth Quarterly Report, 1 Apr.-30 Jun. 1965
Douglas M. Mumma 20 Jul. 1965 9 p
(Contract DA-04-200-AMC-796(X); ARPA Order 546)
(PRQ-024-4; AD-468478)

Explosive gas guns were tested to determine their capability for accelerating projectiles to velocities of 20 000 ft/sec. The reservoir technique was used in most shots. This type of gun uses a pressure tube or piston with a cross-sectional area four times larger than that of the barrel where the projectile is located. Nylon and high density polyethylene projectiles were used: observations showed an intact nylon projectile velocity of 17 900 ft/sec, and a reasonably intact polyethylene projectile velocity of 20 800 ft/sec. A polyethylene projectile was fired from an intermediate size gun, and observations with a high speed framing camera showed that the intact projectile reached a terminal velocity of 18 600 ft/sec. The feasibility of optimizing the explosive weight was studied in an effort to use only 1000 lb of He for a full-scale gun; small-scale shots indicated that, while the explosives can probably be reduced, more study is required for optimizing the design. C.T.C.

N65-31594# Picatinny Arsenal, Dover, N. J. Nuclear Engineering Directorate.
EXPERIMENTAL BASE SAFING DEVICE FOR SHELL APPLICATION Technical Memorandum No. 1472
Charles Hughes Jul. 1964 24 p
(SMUPA-TK-880; AD-465318)

The base safing device is an environmental sensing switch capable of providing electrical switch closures for initiating arming and fuzing devices in nuclear artillery shell. This device utilizes two environments for operation; one is gun tube pressure and the other is setback acceleration. Final functioning occurs only after the shell exits from the gun tube. This report summarizes the experimental development, air gun tests, and gun firings conducted on the device. Author

N65-31632# California Univ., Berkeley. Operations Research Center.
OPTIMIZATION IN OPERATIONS RESEARCH
George B. Dantzig Apr. 1965 11 p
(Contracts Nonr-222(83); Nonr-3656(02); DA-31-124-ARO(D)-331; Grant NSF GP-2633)
(ORC-65-10; AD-618748)

A technique for solving large and unwieldy linear programming problems is presented. The technique, called the decomposition principle, is an application of the Lagrange Multiplier which permits a large number of equations and variables to be separated into a sequence of smaller linear programs. One system to which this method was successfully applied consisted of more than 30000 equations and one million non-negative variables. J.M.D.

N65-31750# Joint Publications Research Service, Washington, D. C.
STOCHASTIC LINEAR PROGRAMMING AND OPTIMUM METABOLISM IN CYBERNETICS
16 Aug. 1965 14 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Kibernetika i Teor. Regulir. (Moscow), v. 162, no. 1, 1965 p 33–35, 201–204
(JPRS-31561; TT-65-32057) CFSTI: $1.00

Two theoretical topics in systems optimization are reported: a stochastic linear programming problem is solved which can be used in determining optimal production volumes where there are initial statistical or probabilistic estimates of ultimate volume requirements; and a metabolism model is formulated which is used to investigate the mechanism of self-adjustment after disturbance of the stationary state in a network of metabolism processes in a mature organism. J.M.D.

N65-31768# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
INTRODUCTION TO TOLERANCE CHARTS: AN ELEMENTARY TREATMENT OF THEIR FORMATION AND USE
Frank Van Dok Nov. 1964 34 p refs
(Contract AT(29-1)-1106)
(RFP-432)

A general introduction to tolerance charts is presented. A tolerance chart is defined, and its purpose and need in industry, and its place in a sequence of events for a manufacturing process are discussed. A format for preparing a tolerance chart is outlined and a test problem is provided. R.N.A.

N65-32076*# Missouri Univ., Columbia.
[A STUDY OF THE LOCATION OF SCIENTIFIC RESEARCH AS AN ECONOMIC PHENOMENON] First Semiannual Progress Report, Feb. 1–Jul. 31, 1965
[1965] 21 p refs
(Grant NGR-26-004-012)
(NASA-CR-64446) CFSTI: HC $1.00/MF $0.50 CSCL 05C

Progress is reported on the investigation of cost structures in research facilities. The studies in this program are directed toward analyzing the effects of clustering or agglomeration on the cost of performing certain kinds of research activities. This involves an improvement in the theory of agglomeration, extending the theory to include research, and the empirical documentation of variations produced in costs (if any) by the presence of other economic or research activity in the same local area. The sequence for the overall project is outlined. Bibliographic and source material have been prepared and a compendium of the listings of all types of research laboratories has been developed. Also, a self-cumulating file has been established and interviews with scientists and engineers in various fields have been conducted. The first-generation and second-generation studies are outlined. The population to be sampled for the first-generation study consists of industrial research laboratories in the United States. The sample design utilizes proportionate stratified, cluster, and simple random sampling principles. E.E.B.

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—NATIONAL AERONAUTICS AND SPACE ACT OF 1958

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